THE

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THE

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1899

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ANGLO-GALLIC WARFARE AND THE "CÂBLISTE ANGLAIS."

EARLY in the present month a series of articles appeared in the Paris *L'Ordre*, which constitute an attack on a French cable company. On the merits or demerits of the accusations advanced one need not offer an opinion. These matters our worthy French neighbours will settle for themselves, and it is not the business of an English outsider to discuss the same.

One of the articles in question, however, happens to touch on a subject of universal interest—a subject, as far as the British nation is concerned, of Imperial interest. It is this to which we venture to briefly draw attention, as hitherto it seems to have passed unnoticed by the Press.

L'Ordre, in its issue of April 4th, publishes a signed article, in which the writer incidentally vouchsafes the following interesting information :—

On board all French warships exist certain sealed orders which, in the event of war, it is the duty of commanders to open and act upon.

These orders include not only precise information as to exact positions of all submarine cables, French and foreign, but also full instructions in regard to the best means for destroying these same cables. The precise words of instruction quoted by the writer of the *L'Ordre* article are as follows :—

Ce sont les câbles au grand-point indiquant la position exacte des câbles francais étrangers, avec indication précise des moyens à employer pour détruire les unes ou les autres de ces lignes.

(Italics in original.)

This, naturally, is a matter of vital interest to Great Britain. As long, however, as the French schemes are known to, and taken into account by, the English Admiralty, and adequate measures for the protection of British submarine cable systems—especially of the important trunk lines—are included in the Admiralty schemes for war tactics, no great harm need accrue to England from the hostile intentions of her Gallic neighbour.

Another matter to which the writer in *L'Ordre* has turned his attention is the non-advisableness of employing in the offices of French cable companies either Englishmen, or even British subjects who have become naturalised Frenchmen, for—one is asked—what confidence, in the event of war, will France be able to place in men who, in their choice of nationality, have been guided merely by self-interest?

It does not seem to occur to the writer of the *L'Ordre* articles that the average Briton would consider himself disgraced were he to betray his employers, and the country, from whom he is deriving pay and daily bread.

One can understand English cable clerks choosing to resign their posts in the event of war breaking out between their adopted and their mother countries—and very few heads of families could afford such heroism—but whilst drawing French pay they would scorn to stab in the dark,

as it were, by playing the low-down game suggested by the writer in the Paris newspaper.

The journal in question ventures into detail in sapient prophesy of what is to be expected of the perfidious son of *perfide* Albion when that young gentleman enjoys the run of a French cable office in war time—war between England and France, be it understood.

May one be allowed to quote :—

. . . . La Compagnie a-t-elle songé à ce qu'elle pourrait faire si ces *Anglais* voulaient en cas de guerre empêcher la France de recevoir les nouvelles d'outre atlantique. *Un coup dans un appareil, une bobine brûlée* et voilà un bureau dépourvu de ses organes les plus indispensables. . . .

(Italics in original.)

This in good old Saxon means that to prevent the reception of war despatches of vital import to France, the son of Albion, above referred to, could, and would, by a furtive dig of a penknife at some internal connection or suspension, cripple the siphon recorder, or, by secretly disconnecting the duplex balance, and continuing to transmit currents, wither up the signalling coil.

In the event of the cable office revelling in the unbridled luxury of a spare recorder, the *câbliste Anglais*, after wrecking one instrument, instead of plotting against the vitals of the spare one, is to make failure doubly sure by playing a much higher game. Fertile in resource he goes for the condensers!

. . . . puisqu'il suffirait de remplacer un fil métallique par un fil non conducteur entre les vis de communication de deux des condensateurs assez nombreux pour qu'il soit impossible de trouver le point où serait la "faute." . . . . Les mêmes observations s'appliquent aux *piles Leclanché* qui donnent le courant nécessaire aux câbles.

This, one must presume, means that the *câbliste Anglais*, the chief phrenological characteristic of whose cranium appears to be a pronounced bump of secretive and treacherous destructiveness, seizes some convenient opportunity for bending sharply, to and fro, a condenser connection of covered wire, so as to sever the conductor, without, however, affecting the outer appearance of the connection.

One knows that the French employé who acted as technical adviser and informer to the Paris newspaper representative in no way worthily represents his good French colleagues, many of whom possess excellent technical knowledge.

His idea that a secret disconnection between any two condensers, or between any two cells of a sending battery, would permanently cripple the working of a cable office, is extremely ridiculous, even without reference to the fact that the condenser outrage suggested would, under many conditions, merely modify the signals without interrupting them. The technical adviser evidently imagines that condensers are joined up like battery cells, viz., *in series!*

Truly it is hard to decide which idea is the more ludicrous, that which taxes the British cable clerk with treacherous intentions towards his employer, or that which presupposes the existence of a responsible cable official incompetent to localise and rectify such puerile though malevolent trouble as that suggested by the Paris newspaper.

The idea naturally presents itself that the French gentleman who, in his suggestions to the *L'Ordre* representative, has evinced so profound a misconception of cable office technics, must probably have been found not worth his salt by his own French chiefs—which circumstance might account for much bias.

However, in inspiring the Paris Press with such mistaken notions as to the low standard of honour to be expected among the British *personnel* of French cable companies in war time, the worthy informer has rendered one good service. He has shown what direction his own playful ingenuity would take in the event of his gaining access, by hook or by crook, to any British cable office. "Forewarned is forearmed!"

Marconi Telegraphy.

The successful transmission of messages between South Foreland and Boulogne appears to have at length extracted from scientific men in this country a somewhat tardy recognition of the merits of Signor Marconi's invention; at least, if we are to suppose that Prof. Fleming speaks for the scientific world in his letter to the *Times* of the 3rd inst. Prof. Fleming has seen Marconi's apparatus at work at South Foreland, and he says: "No familiarity with the subject removes the feeling of vague wonder with which one sees a telegraphic instrument merely connected with a length of 150 feet of copper wire run up the side of a flagstaff, begin to draw its message out of space and print down in dot and dash on the paper tape the intelligence ferried across 30 miles of water by the mysterious ether." While pointing out the limitations of wireless telegraphy, Fleming considers that it should be without delay applied in marine signalling, in the many cases where communication by cable is impossible. When some method of detecting the distance of the transmitting apparatus has been devised, the value of the system in preventing collisions and shipwrecks ought to be immense. It would be rash to assert that this desirable improvement is impossible. Another improvement that is much to be desired, is some means of concentrating the stream of waves in one direction, or at least preventing the escape of the waves in undesired directions. This, let us hope, is also within the power of science. The proposal to transmit messages across the Atlantic appears to us to be rather wild; at least the conditions are by no means the same as in the successful experiments already carried out, since the ether waves would have to pass through a considerable mass of sea or earth, or else travel in a path very much removed from the orthodox straight line.

Electricity v. Steam on the South Side Elevated Railroad, Chicago.—The New York *Electrical Review* has received the following interesting figures regarding the comparative operation of the South Side Elevated Railroad of Chicago by steam and electricity. The figures are for the months of November and December, 1897 and 1898, the first strictly comparative months in the operation of the road. The road, including "loop" operation, 19·44 miles of track, in 1897 was operated entirely by steam, and in 1898 entirely by the Sprague multiple unit electric system. In addition to all "loop" expenses, there is a rental charge equal to 10 per cent. on the gross passenger receipts of the road. This should be considered really as an interest charge not as an operative expense. For these two months the comparative table following shows:—(*a*) Ratio of expenses to earnings, including "loop" rental, taxes, and licenses; (*b*) ratio of expenses to earnings, excluding "loop" rental, but including taxes and licenses; (*c*) net earnings:—

		(*a*)	(*b*)	(*c*)
November, 1897, steam	...	87·3	77·7	$10,603.80
" 1898, electric	...	57·3	47·7	$39,448.56
December, 1897, steam	...	83·6	73·6	$14,691·69
" 1898, electric	...	55·0	45·4	$45,355.68

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

In the early days of electric traction motor cars were simply replicas of horse cars in design, and the general distribution of their essential parts was the same. The first modification introduced was a progressive stiffening of the underframe of the car body to make it strong enough to support one end of the motors, the other being slung directly from the axles. A comparatively short experience showed, however, that an underframe of the horse car type could not be made sufficiently strong to satisfactorily support the motors, and that the pitching of the car bodies in the vertical plane interfered most undesirably with the working of the motors.

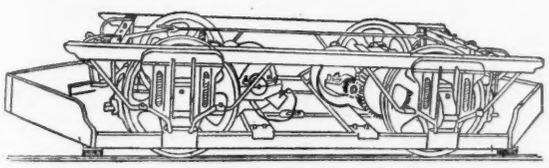


Fig. 1.—Early Bemis Truck.

The modern electric car truck owes its origin to the attempts made to overcome this difficulty, and without it the present successful working of electric tramways, both in the New World and the Old, could never have been achieved.

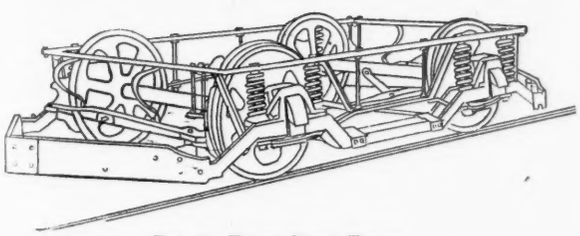


Fig. 2.—Early Brill Truck.

The idea of a separate truck to carry the motors as well as to support the car bodies once evolved, inventors turned their attention to devising new types and perfecting details, to removing defects in the trucks as they became apparent, and to meeting ideal requirements.

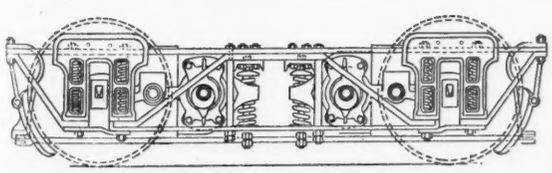


Fig. 3.—Early Peckham Truck.

The original type of independent truck consisted of four pedestals or yokes, between the jaws of which the journal boxes were held, and to which were attached an under and an

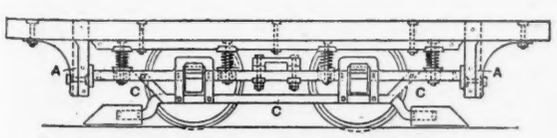


Fig. 4.—First Peckham Extension Truck.

upper frame. These frames were progressively strengthened vertically, horizontally, and transversely, to enable them to support the motors which were suspended thereto by cross bars. On the upper frame the car body itself rested. Figs. 1, 2, 3, 4, 5, 6, 7 and 8 illustrate various steps in the evolution alluded to. Nos. 1 and 3 bear the unmistakable imprint of the prototype horse car, the lower frame being evidently introduced to furnish the support for the motor platform. No. 2 shows how this lower frame was made more directly part of the pedestals, with the object of reducing the bracing between it and the upper framing, and it also shows the

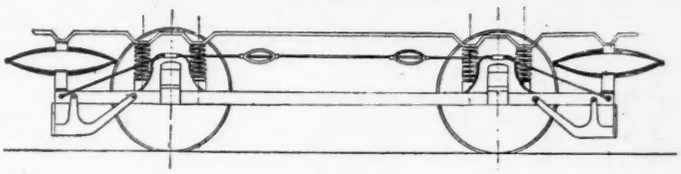


Fig. 5.

evolution of the principle of the double yoke and curved framing. Nos. 6, 7 and 8 are developments of this double yoke principle to meet the requirements of an extended truck platform.

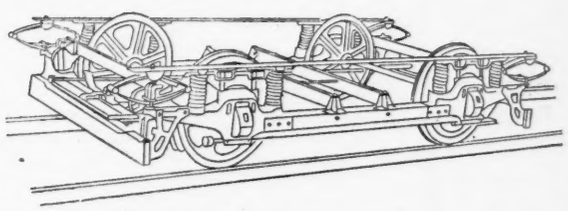


Fig. 6.—Bemis Extension Truck.

The trucks illustrated in Nos. 4 and 5 are examples of the first attempts to introduce the principle of the braced cantilever into the construction of trucks with an extended platform. The first dates back to the year 1890, and represents the type of braced cantilever with a strutted bracket which has been adopted with such success in railway bridge building. Here the top frame of the truck was entirely dissociated from the underframe of the car and lowered to

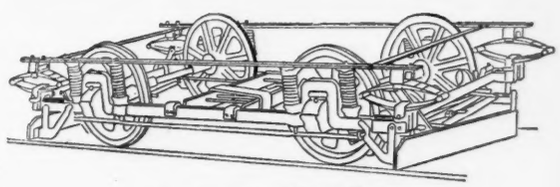


Fig. 7.—Brill No. 1 Truck.

the level of the under side of the pedestal forks where it became the top boom of the truck truss, the lower frame being kept on the level with the bottom of the pedestals and becoming the lower boom, the pedestals forming a part of the framing between the two booms of the truss. No. 5, on the other hand, was an attempt to utilise the suspension principle in the framing of the cantilever car truss, the lower boom in this case was the main boom of the truss and its projecting cantilever ends were stiffened by suspension

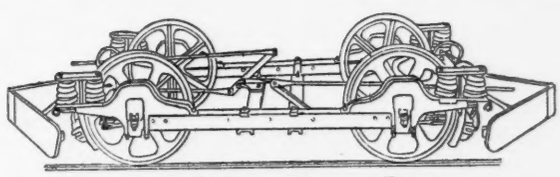


Fig. 8.—McGuire Extension Truck.

members passing over the pedestals. In railway bridge building this principle has also found numerous applications, but it cannot be said to have been nearly as successful as the strutted bracket previously mentioned. The two when used in connection have, however, afforded most satisfactory results, as instance the famous Forth Bridge which was built on the combination of these two principles.

There are three possible forms or combination of forms of truck to support car bodies:—First, the single four-wheel rigid base form; second, the multiple six-wheel radial or hinged form; third, the duplicated four-wheel rigid base form or double independent bogie. The first for ordinary street motor cars has the merit of simplicity and economy, the second is expensive and liable to leave the track on reverse or S curves, while the third becomes necessary when the motor car expands into the large interurban railway motor carriage.

To fulfil the requirements of electric traction a truck must possess the following qualities:—

1. The weight must be reduced to the minimum consistent with rigidity and strength.

2. The bracing must be so disposed as to keep the truck stiff and true to form independent of the car body under the extremely severe strains produced by rounding sharp curves and passing from the level on to a gradient, and to counteract any tendency in the car to droop at the ends.

3. The journal boxes must be dustproof and self-lubricating, and require a minimum of attention.

4. The brake action must be simple and effective, powerful and easy of adjustment, the brake blocks must be readily and quickly replaceable, and their position must be unaffected by the spring motion of the car itself.

5. The general arrangement of the truck must be such that the essential parts (*i.e.*, motors, wheels, axles, journal boxes, brakes, &c.), can be easily and promptly got at for removal without dismembering the car.

6. The car body must be attached to the truck so as to be readily removed by loosening a few bolts without jacking up.

7. The springs must be so disposed as to ensure equally smooth car running when light or fully loaded, and prevent pitching due to momentary inequalities of loading, or longitudinal track imperfections, as well as rolling due to entering or leaving sharp curves or transverse track imperfections, and, lastly, entirely do away with metal jars and the pounding of rail joints and switches.

8. The wheels and axles must be of appropriate form and construction.

9. All strains on bolts must be reduced to a minimum so as to avoid their working loose.

10. Accurate construction must be assured to reduce cost of maintenance to a minimum.

11. In the case of the single four-wheel truck, the wheel base must be reduced to between 5 feet 6 inches and 8 feet and yet efficiently support a heavily loaded car from four to five times the length of the wheel base.

12. In addition to the desiderata mentioned under 7, the attachment of the car body to the truck through the springs must be such as to minimise wear and tear in the car body itself, as well as in the wiring, and avoid possible motor destruction through short-circuiting.

By far the greater number of cars on our tramways belong to the first, or "four-wheel truck type," with a rigid base reduced to the minimum length consistent with efficient support for the car body under all conditions of loading. This is unavoidably necessary on the tramway installations in the older towns in Europe, where the streets are comparatively narrow and tortuous, and where the passage of cars with long bodies mounted on bogie trucks would be a practical impossibility. The American truck builders have specially devoted their attention to completely solving the problems involved by these conditions. The building of motor trucks was quickly recognised to be a speciality, and the builders became specialists. The same methods were applied to developing and perfecting trucks which have been applied with such conspicuous success to machinery generally in the United States. These methods consist essentially in perfecting details rather than in modifying or altering fundamental ideas, and in gradually standardising these details in accordance with the requirements of practice, and not as is usual in Europe by indefinitely varying them to meet the requirements of each individual case.

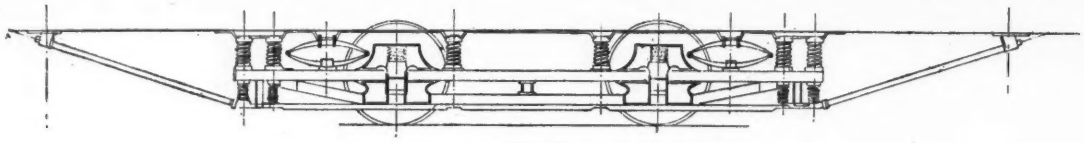


Fig. 9.

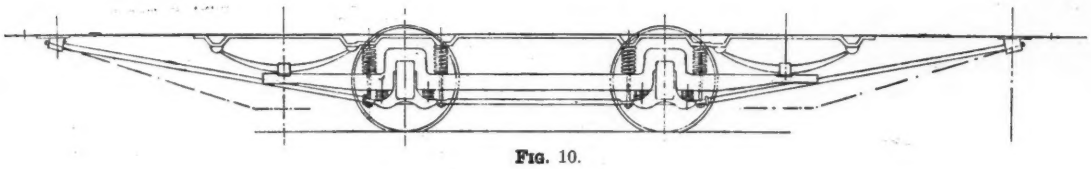


Fig. 10.

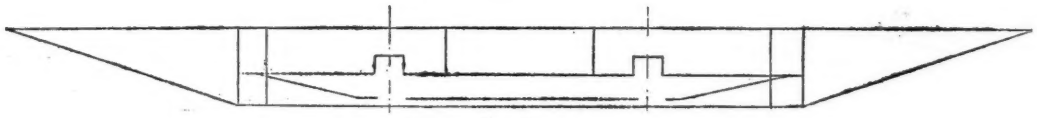


Fig. 11.

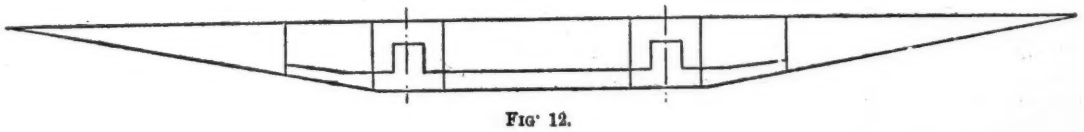


Fig. 12.

The first attempts to introduce the braced cantilever principle in truck trusses, delineated in figs. 4 and 5, were due to Mr. Edgar Peckham and Mr. G. G. Brill respectively. These types were designed to increase the spring base of a truck, with a limited rigid wheel base, so as to afford adequate support to a car body of ever increasing dimensions both in width and length.

The truck truss extended on the cantilever principle was very soon recognised to be the type which alone could afford satisfactory support to both car bodies and motors. Its chief and crowning merit lies in the combined stiffness and strength produced by the braced trusses of which it is composed. The fundamental principle of the braced cantilever truss being once admitted as the best for the extended truck platforms, the question of truck design resolved itself simply into the perfecting of the details. The type embodied in fig. 4 proved susceptible of indefinite improvement, while that in fig. 5, for reasons mentioned below, did not, and it has practically been abandoned by the constructors for an unbraced cantilever bracket.

The stiffening of the cantilever projections by suspension rods, as shown in fig. 5, was found in practice to possess the distinct disadvantage of involving the constant taking up of

the elongation of the rods by the tightening of the couplings, and the constant liability of the cantilever projections to droop, while the repeated increase of strain thus thrown on the underframing of the car platforms tended to permanently put them out of shape. The lower boom of the truss, as shown in fig. 5, was completed across the jaws of the pedestals by straps, bolted below them; these were directly liable to deformation through the drooping of the platforms, and the straps being bent, the distance between the jaws of the lower ends of the pedestals was reduced so that difficulty was experienced in slipping out the axle boxes when the wheels required removal, and the springs in the yokes became practically useless. These drawbacks induced the Brill Company to abandon the stiffening of the cantilever ends by the suspension principle, and to substitute unstiffened solid brackets therefor. Figs. 9 and 10 are examples of the standard extension cars constructed by the Peckham and Brill Companies in their latest practice, drawn to the same scale, from which their essential differences become readily apparent. Figs. 11 and 12 are diagrams showing the way in which the cantilever truck trusses have been combined by the two companies with the stiffening truss under the car frames. For the purpose of extending the support afforded by the truck to the car body, the trusses have practically become part and parcel of each other. The essential differences between the two trusses are also clearly apparent from these diagrams. The support afforded to the car platform in the form delineated in fig. 11 is obviously superior to that in fig. 12 in possessing additional struts outside the elliptical springs, an arrangement which admits of the angle of the inclined extension rods being kept constant, notwithstanding the lengthening of the car platforms, while the arrangement in fig. 12 does not. The design in fig. 11 constitutes a truss in connection with the truck in which the amount of metal employed is utilised to the best advantage to produce stiffness combined with strength, while in that of fig. 12 the metal employed is as obviously not utilised to the best advantage to secure these objects.

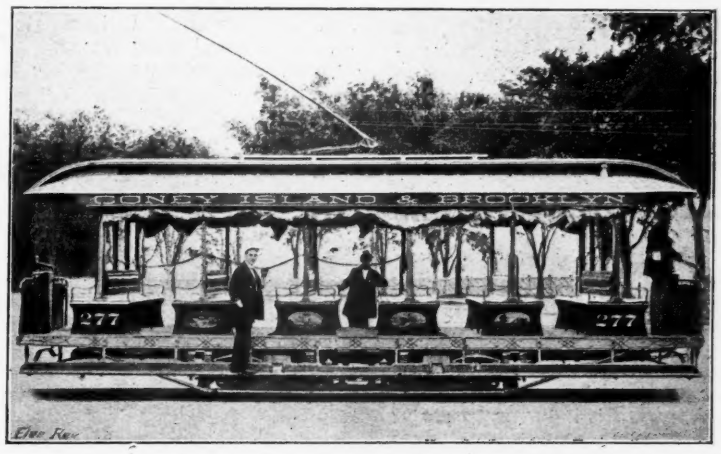


Fig. 13.—35-Foot Open Car on Peckham Single Truck.

A moment's glance at figs. 9 to 12 will show that for the same wheel base, the spring base of the type shown in figs. 9 and 11 is much greater than that shown in figs. 10 and 12, and that the inclination of the raking members of the extension truss is much more favourable for affording support in the former than in the latter. Also that whereas the underframing of the car body serves to materially increase the strength and resistance of the same to bending moments at the ends or to counteract the tendency to drooping in the former, this is not at all the case with the latter truck.

The adaptation of the extension principle in the truss shown in figs. 9 and 11 is evidently the only practical solution of the problem involved in the ever increasing demand for longer car bodies supported on a single four-wheel truck of a limited wheel base. The following table gives the maximum rigid wheel base that can be employed on curves of restricted radius without danger of running off the rails under ordinary conditions of tramway permanent way, and without guard rails:—

Table I.

Minimum radius of curve in feet	20	25	30	40	50	60	70
Maximum rigid wheel base in feet	5'4"	6	6½	7	7½	8	8'5"

To use a rigid wheel base of 6½ feet on a curve of 25 feet radius with safety, or one of 7 feet on a curve of 30 feet radius, it would be necessary to ensure that the line was laid exactly to gauge and also to provide check rails. Neither of these special provisions being practicable on ordinary street tramways, it is clearly apparent that the difference of a few inches in the length of the rigid wheel base may make all the difference between a safe and uninterrupted service on a given system and one constantly subject to delays through the derailment of the cars circulating over it. Under the conditions generally met with in street service, it is found to be impracticable to lengthen the rigid wheel base much over 7 feet, and hence it is imperative to supplement this short wheel base by as long a spring base as possible, or in effect to substitute for the deficient wheel base an extended spring base so that the modern long cars should be supported on their springs as far apart proportionately, as they would have been on the pedestals in which the axles worked, had the obsolete horse car arrangement been followed out in present instance. The height of the car platform on the sills above rail level is practically a fixed quantity in street tramways—in ordinary cases it amounts to from 27 inches to 30 inches which may be said to be a maximum—so that there is very limited space for the underframing and trusses, this space is considerably less than the diameter of the wheels. The difficulty involved by these conditions becomes immediately apparent when it is remembered that the resistance offered by a truss to bending varies directly as the cube of its depth. The combination of the car underframe truss

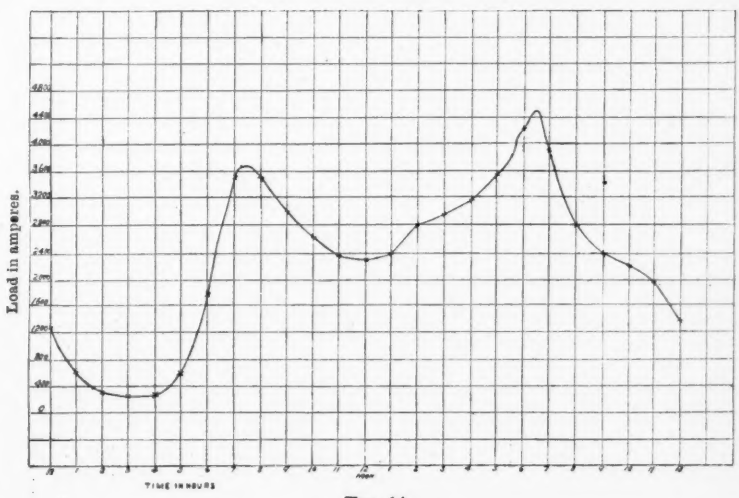


Fig. 14.

Curve Showing Variation in Load at Different Times of the Day.

with the truck truss on the extension principle by which the extension rods instead of terminating at the extremities of the truck frame are carried below and around the lower member of this frame, and are stayed to the car sills by bolts passing through the truck pedestals and end springs, as shown in figs. 9 and 11, has completely met and overcome these difficulties by utilising the space occupied by the truck trusses to secure the depth required for the car body trusses. This arrangement has afforded a practical solution of desideratum No. 11 mentioned *ante* as required by the ideal truck for electric traction purposes, and has rendered it practicable to operate upon single trucks with a 7-foot rigid wheel base, car bodies up to 35 feet in length (fig. 13). This length of body must be considered to be a maximum, as far as electric tramways in the older cities of both Continents are concerned; but it also amply demonstrates the practicability of constructing all the rolling stock required to work them with ordinary single trucks, and consequently of running them with a maximum economy of driving power which would not have been possible had swivelling or bogie trucks been unavoidable, the loss of power in these due to friction of wheels on track and friction of swivel plates, being necessarily greater than that in a single truck.

A few words upon the relative advantage of a service conducted by single truck cars as compared with double truck cars may not be out of place. The accompanying load diagram (fig. 14) of an ordinary city electric tramway is typical of most city work, and shows distinctly that there are two maxima per 24 hours, one in the morning and one in the afternoon, when the number of passengers to be carried is greatest. The disadvantage under which a car of relatively smaller seating capacity, such as a single truck car, invariably must labour at these times is obvious; but this disadvantage has been overcome by adding, temporarily, a trailing car to the motor, and this arrangement seems to afford the most practical solution of the difficulty in crowded centres with dense traffic, such as the older cities possess. The multiplication of the carrying units or the increased frequency of their circulation, is the most convenient ideal for a dense traffic, and if in addition to this multiplication of units, by the device of attaching a trailer to each motor car, the carrying capacity of the unit itself can be momentarily increased by, say, 50 per cent. (bringing it up to over 1½ times the capacity of a double truck car), to meet the requirements of the morning and afternoon maxima, all that is possible will have been done to meet the requirements of the traffic in question. The cost of working a single truck car service with added trailer at the periods of maximum traffic is not greatly in excess of that of a double truck car service. The following tables give the relative cost of working on two tramways in the United States, the one with a single truck car service with trailer added on 26 per cent. of the trips, the other with a double truck car service, both having a daily average car mileage of 115.

Table II.—Cost per 1,000 Passengers Carried.

	Single truck cars.	Double truck cars.
Motor cars, renewals of wheels and brake blocks	19d.	23½d.
Trailers " " " "	2½d.	"
Motor cars, repairs and maintenance of trucks ...	39d.	40d.
Trailers " " "	5d.	...
Motor cars " " motors.	69½d.	70½d.
	135d.	134d.

Table III.—Power Expended.

	Average No. of seats.	Weight tons.	Average watt-hours per car mile per 100 passengers.
Single truck cars and trailer (added on 26 per cent. of trips) ...	35 28	10·5	7·9
Double truck cars	36	11·75	5·9

(To be continued.)

THE ELECTRIC CURRENT IN CHEMISTRY.

It is now almost a century since Volta, the Italian physicist, wrote the following words:—

"I have made experiments, showing the transmission of the electric fluid .... I have applied different metals to all sorts of animal bodies .... even to such substances as paper, leather, linen (well saturated with water), as well as to water itself .... The metals are not only conductors of electricity, but they also excite it, and this is a grand discovery."

It was, indeed, a "grand discovery," for it led to further investigation with the final demonstration that "animal and metal electricity" were identical. What is more, it opened the way to the construction of the battery bearing the name of this honoured investigator, who little dreamed of the splendid achievements which were to follow the introduction into chemistry of the form of energy thus made so readily accessible.

Volta failed to observe the decomposition which arose upon immersing the terminals of one of his cells in water. That was to remain for the keener vision of Nicholson and Carlisle. The chemical phenomena, exhibiting themselves constantly to Volta while experimenting with his battery, were to him absolutely devoid of interest, yet they eventually attracted the attention of a brilliant coterie of investigators, whose discoveries could never have come in their most shadowy forms to Volta in his wildest dreams. In evidence of this may be mentioned the electrolytic decomposition of water, the deposition of the metals lead and silver (probably the beginning of electro-chemical analysis); the remarkably mysterious and quiet passage of oxygen from the end of the silver terminal over to the zinc terminal, where it appeared as gas—all observed by Cruikshank; the discovery by Davy that the current set free hydrogen and oxygen from water in the proportion in which they united to form the parent substance; the conclusion reached by Ritter that reduction invariably took place at one pole while oxidation occurred at the other; the evolution of Grothuss' theory in regard to the decomposition of liquids generally by the current—a theory highly suggestive in various directions; (the esterification theory of Williamson is based upon the same idea of alternate decompositions and re-formations) and the magnificent conquests made by Davy, culminating in the isolation of the interesting and valuable alkali metals, sodium and potassium, giving to the chemical world not only two new elements, but also inciting students the world over to research in wide-reaching fields—a discovery pronounced by Ostwald to be "the close of the first act of the electro-chemical drama."

But richer discoveries were to follow. We may recall the labours of Berzelius and Hisinger, upon which was founded a theory now almost forgotten, and in its day a retarder, in some measure, of the proper understanding of simple chemical combinations. But it was helpful, and contributed, at least, a mass of facts, applied successfully later in the solution of various chemical problems.

Then mention must be made of Becquerel, de la Rive, and Pfaff, who contributed much of lasting value during the controversy waged by the adherents of opposing schools in regard to the origin of the current, in the midst of which appeared the immortal Faraday, fixing the relation between the electrical magnitudes and the combining numbers of chemistry, really taking the initial steps in the foundation of the quantitative period of electro-chemistry. Reference to his work might fill columns, but it is sufficient to mention his identification of "machine and Volta electricity"; his declaration concerning electro-chemical decomposition that "the effect is produced by an internal corpuscular action, exerted according to the direction of the electric current, and that it is due to a force either superadded to or giving direction to the ordinary chemical affinity of the bodies present"; his suggestion, after wrestling with the nomenclature of that prevalent in electro-chemistry, of the terms anode, cathode, electrode, ion, &c.; his efforts to measure electricity when he wrote "that the decomposing action of the current is constant for a constant quantity of electricity," and following this thought constructed an instrument which, "being interposed in the course of the current used in any particular experiment, should serve at pleasure either as a comparative

standard of effect or as a positive measurer of this subtile agent." Again, having repeated all his earlier experiments with the most varying conditions, he wrote, "variations in the intensity . . . . produced no difference as to the equal action of large and small electrodes"; and when he had completed his volta-electrometers they were so arranged that "after the current had passed through one it should divide into two parts; these, after traversing each one of the remaining instruments, should re-unite. The sum of decomposition in the latter two vessels was always equal to the decomposition in the former vessel . . . . exactly the same quantity of water was decomposed in all the solutions by the same quantity of electricity." When the current acted upon caustic soda or potash, magnesium sulphate or sodium sulphate, just as much hydrogen and oxygen were evolved from them as from the diluted sulphuric acid with which they had been compared. And then there is his final declaration in regard to water "that when subjected to the influence of the electric current a quantity of it is decomposed exactly proportional to the quantity of electricity which had passed."

Brief allusion must also be made to the electrolysis of molten salts, also conducted by Faraday. It has been said that the data communicated by Faraday, as the result of his years of observation of the action of the electric current upon chemical compounds, are among the most important in the history of electro-chemistry. They form the basis of all the quantitative laws which have been developed in this special field. They merit place side by side with the law of combining weights.

Equally important, perhaps, both from a theoretical and practical standpoint have been the results recently won by the introduction of the current into the field of pure chemistry through the persistent efforts of untiring investigators. In the diffusion of solids in their solvents, van't Hoff perceived a similarity to the expansion of gases; he succeeded in measuring that diffusive, expansive force bearing the name osmotic pressure, a discovery possessing the most important consequences. The simple relation between gas volume, attending pressure and temperatures, had led Avogadro to promulgate his hypothesis in regard to molecules—a thought considered as a fundamental in our science. This hypothesis van't Hoff made bold to apply to solutions, and there resulted a theory for solutions analogous to that previously wrought out for gases. To-day molecular weight determinations are made almost daily in our research laboratories as an indirect consequence of this deduction. Indeed, the laws governing osmotic pressure, when applied in the most varied forms, remained satisfactory, except with solutions of salts, bases and acids. Their osmotic pressure was far beyond what could be expected from the theory of van't Hoff. How was this to be explained? The answer came from Arrhenius (1887), who showed that the departure from law is due to dissociation, and that the dissociation of bodies in their solvents occurs only in the case of those which conduct the electric current, *i.e.*, with electrolytes. Compounds not dissociated in aqueous solution—which adhere to the law of osmotic pressure—do not conduct the electric current. There remained but a step to the assumption that the products of dissociation, in aqueous solution, were identical with the substances termed ions, which in electrolysis appear at the electrodes. A logical query, consequent upon this declaration, was:—

Are, for example, free potassium and free chlorine present in an aqueous solution of potassium chloride? Ostwald's reply to this question was:—"What actually exists in the solution are single potassium atoms with enormous electrical charges. We do not know what these charges are in reality, but this we know, that the chemical properties of substances are greatly altered by electrical charges. On the other hand, what we know as free potassium is a solid substance whose molecules consist of potassium atoms not charged with electricity at all. . . . . As soon as the potassium atoms in solution lose their charge, as they do, for example, when led by an electric current to a platinum wire, where they can give up their electricity, potassium with its ordinary properties is at once produced."

A further consequence of osmosis and that of free ions in solution is Nernst's theory in regard to electric current in the voltaic cell.

(*To be continued.*)

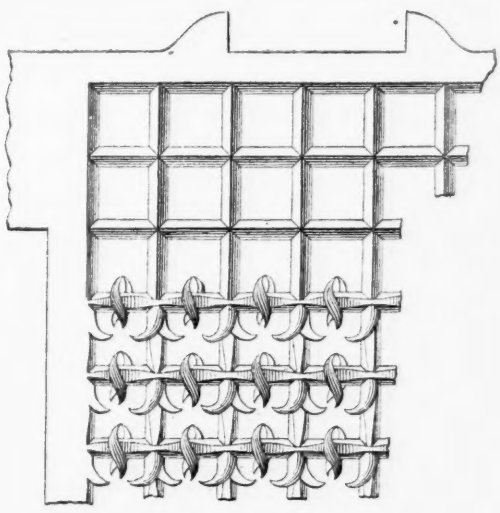
THE PESCETTO STORAGE BATTERIES.

In a communication to the Associazione Elettrotechnica Italiana, dated so far back as October, 1897, Lieut.-Col. F. Pescetto gave some details relative to the secondary battery plates of the Société Italienne d'Electricité, constructed on the Cruto system. His paper has been reproduced in *l'Industrie Electrique*, and it would appear that the details in question are applicable to the Pescetto storage battery we mentioned—with special reference to the data furnished in the very elaborate catalogue of the company formed to construct and supply this battery—in our last issue.

We hope that information of a more recent date and, we may add, of a more satisfactory character in regard to certain points of practical importance, may be shortly forthcoming. In describing the grid supports for the active material, M. Pescetto says:—

"The plate of the Société Italienne d'Electricité, on the Cruto system, appeared to me to be the one that most effectively conducted the current into the mass of active material, and that enveloped every portion of it so as to prevent its becoming detached, whilst at the same time it combined the conditions required for lightness. In this plate the bars have a transverse section (*sic*) very high in relation to the width. (This statement is not at all elucidated by the diagram reproduced below, which accompanies the description.) With a knife (?) cuts are made in the bars, by means of which, on each face and for each aperture, four prongs are produced, with their points in the direction of the centre of the hole. If the grid were simply of lead, the points would be very quickly corroded by the chemical reactions. They are rendered much more durable by the substitution for lead of an alloy of this metal inattackable by the electrolyte."

Now, unless the "knife" above mentioned forms part of a rapidly acting mechanism; if, that is to say, the prongs have to be produced by hand labour, the process of manufacturing the grids does not appear to be commercially practicable. It would fail in practice by reason of too much *main-d'œuvre*. For there are already in existence grids produced by processes of casting, which are probably as efficacious in retaining the active material as those with the eight projecting prongs to each alveole. As to the alloy, inattackable by dilute sulphuric acid in which it constitutes the anode, we have heard of such a body, at intervals, during the last 18 years; but experience has not shown that any alloy answers the required purpose better than pure lead. And we are told that, in the case of a grid of pure lead, the distinguishing characteristic of the Pescetto support would rapidly disappear by corrosion.



We have no intention of entering upon a lengthy criticism of M. Pescetto's paper, for it is quite possible we might be informed that the shortcomings insisted upon have for some time past been remedied. The superiority which is claimed for this form of storage battery is, probably, mainly

dependent upon the physical condition of the active material, brought about by the admixture with the oxides of lead of a subtance, termed by the writer the *ulmate of ulmin*, obtained by boiling sugar with dilute sulphuric acid. This substance, brown in colour, is sparingly soluble, and would, no doubt, be eliminated from the peroxide active material, not merely in virtue of this solubility, but by oxidation. It is conceivable that its gradual elimination would leave the active material in a condition of porosity, allowing access of the acid to the interior of the mass, and thus practically augmenting its capacity, without impairing the conductivity of the peroxide. This agglutinating material is said to confer a certain degree of elasticity to the plate, a statement which appears to suggest that it would resist the oxidising action of a lead anode in dilute sulphuric acid. But the elasticity in question, supposing it to exist, must be referred to the peculiar physical condition of the peroxide material, for it appears quite certain that no compound belonging to the series which includes ulmic, humic, and geic acids could withstand the oxidising action above mentioned.

It is stated in the paper that, according to the experiments carried out during a year by M. Carmine Siracusa, the director of the manufactory belonging to the Cruto Company, the specific (energy) capacity of the new cell varies, according to the rates of charge and discharge, as follows:—

Per Pound of Plates.

Rate of charge, amperes.	Rate of discharge, amperes.	Capacity, watt-hours.
·90	2·09	11·8
ditto.	3·90	10·9
4·54	2·09	6·0
ditto.	3·90	5·45
9·09	2·09	3·18
ditto.	3·90	3·09

STEAM TURBINES.

By RANKIN KENNEDY.

(*Continued from page* 399.)

We may consider the De Laval turbine as the modern perfected free jet turbine; in it the high velocity has been accepted as inevitable, and by clever mechanical devices the difficulties of high velocity have been met and overcome, as far as they possibly can be, except in the case of gyroscopic

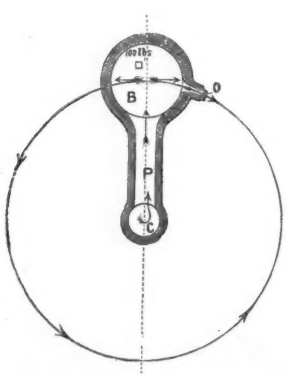


Fig. 12.

effects on board ship; a flexible shaft is all right in a turbine on a fixed foundation, but it cannot resist bending, due to movements of its bed-plate.

It is, of course, immaterial in free jet turbines whether the fluid enters by the side (or flows axially), the outside or the inside of the periphery of the wheel, that is, in the language of the hydraulic engineer, it makes no material difference whether it is an outward, inward, or axial flow turbine. The choice between these forms is made for mechanical reasons and ease of construction; the axial flow adopted by De Laval seems to meet the requirements in a wheel, mechanically strong, and easily made.

We now turn to the pressure turbine; it has not yet been perfected, but is of great interest. Fig. 12 is a diagram showing a metal globe, fed by high pressure steam through a joint, *c*, in a pipe, P, free to move round the joint in a circle. The globe has a nozzle, *o*, on one side; we may thus get a pressure of, say, 100 lbs. per square inch on the inside of the globe, the supply pipe being so much larger than the nozzle that the pressure is maintained constant. Now, suppose the orifice of the nozzle is half a square inch in area, it will be

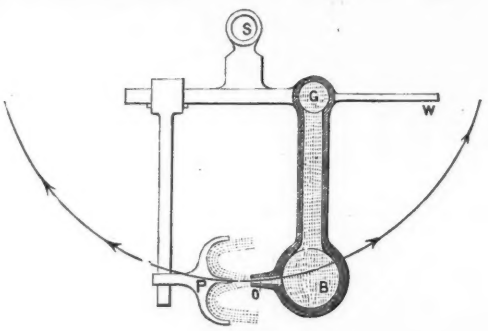


Fig. 13.

evident that on the side of the globe opposite the orifice there shall be a half square inch more surface for the steam to press against than on the orifice side, and this will give a pressure of 50 lbs. pushing the globe round in the direction of the arrows in opposite direction of the jet.

It will be clear that the motion is purely due to unbalanced pressures, one side of the globe is reduced in area by the amount of the area of the orifice, hence the force pressing on the opposite is unbalanced, this is the principle of action of pressure turbines.

Fig. 13 shows by diagram an experiment proving that the two kinds of turbines may balance each other in pressure, and is of value to us when we come to calculate the power of turbines, here a jet issues from a globe and strikes on a curved

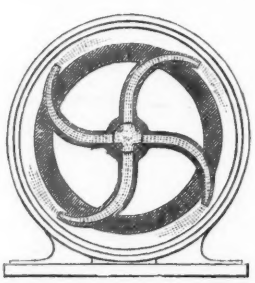


Fig. 14.

blade, if they are properly adjusted there is no motion on the pivoted centre, C, for the back pressure on the globe is exactly balanced by the pressure of the fluid thrown against the blade, this result greatly simplifies the arithmetic in our calculations later on.

If we remove the curved blade, a weight to balance the back pressure must be fixed on the end of the balance at W, and this weight will be proportional to the area of the orifice multiplied by the pressure.

One condition of perfect action will be obvious, and that is the supply pipe to the globe, or more strictly speaking to the orifice, must be so large that the full pressure is maintained right up to the orifice, if the supply pipe is small the boiler pressure may be 100 lbs. while only 20 lbs. is maintained in the globe. Old Hero seems to have realised this, for he placed the nozzles right on the boiler and let the boiler rotate, the boiler being one with the engine.

Several attempts to make practical turbines on this pressure principle were made about 50 years ago in

Glasgow district, one shown in fig. 14 was used for a fan blower, and another, fig. 15, was used for driving a circular saw direct. Eminent Scotch engineers, Ruthven, Nasmyth, Gorman, and the versatile Swede, Ericcson, made steam turbines much on the same lines as these illustrated.

Fig. 14 has steam orifices on the end of curved supply pipes, it is safe to presume that full pressure was not maintained behind the orifices, and that thereby much effect was lost, and that owing to the difficulty of balancing such a rude wheel, the speed would be far below anything approaching that of economy.

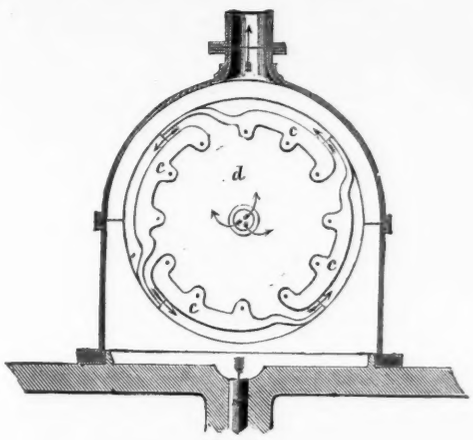


Fig. 15.

Fig. 15 is a better design. The nozzles are formed between two discs by shaped pieces, c, c, c, c, making a hollow case for steam supply.

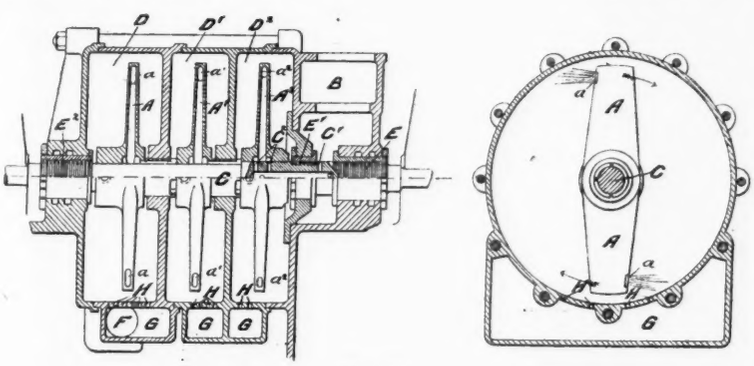


Fig. 16.

Realising that these wheels had to run at speeds beyond what these engineers could meet, with the limited means at command, the plan of putting several in series was soon proposed with a view to better economy in steam, at the then obtainable velocities, but we need not here refer further to these early turbines.

We find Parsons with a proposal for a pressure series of turbines in Patent 8,854, 1893. Fig. 16 is an end sectional elevation and a side sectional view of three turbines in series.

It will be at once obvious how the supply pipes, A, A, are made large enough. Fig. 17 is a section of the pipe, A, showing the orifice, *a*.

The steam enters by a hollow shaft at C^1 and C^2, and then, from one compartment, to next wheel by a sleeve round the shaft. The difficulties in the construction are plainly seen, the sleeves must fit steam-tight into the partitions between the compartments, and the hole in the shaft and the clearance between the sleeves and the shaft must be large, to prevent fall in pressure behind the orifices; wire-drawing the steam in a pressure turbine is fatal to their economy.

It will be observed that the orifices in the first turbine are smaller than the second, and the second smaller than the third; this is to allow for the increased volume of the steam as it expands from one to the other; but, to be consistent, the supply passages should also be increased in area, thus introducing more mechanical difficulties.

It is of no use expanding the orifice beyond the area equal to the inlets of the steam; if the steam cannot be maintained at high pressure immediately behind the orifices, that is at *c*, in fig. 17, then the driving effect is obviously lost.

More about this expanding principle in turbines will be said when we come to consider the calculations to be made.

It may be pointed out that these pressure turbines work just as well if we put the pressure outside and let the fluid flow in; in fig. 16 the casing may be filled with steam at a pressure flowing into the orifices, the wheel would then revolve in the opposite direction, and thus a reversible turbine has been arrived at; for marine engineering work a reversible turbine is necessary.

These turbines now under discussion act purely by pressure difference, require no guide blades, and like the free jet impulse turbines are essentially very high speed turbines, so that all the balancing and other devices required for high speeds must be applied to them.

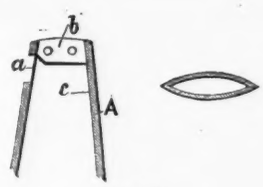


Fig. 17.

In this form the pressure turbine is not very suitable for series working. It has already been pointed out how essential it is to have full pressure behind the orifice. A glance at fig. 16 will show that after passing through the first turbine, the quantity of steam which has passed the smallest nozzles or orifices cannot possibly maintain a pressure behind the orifices of the larger size further on, so that the work will be nearly all effected in the first wheel, that is the great drawback to this pressure turbine.

It works perfectly but with little economy as a single wheel.

It has, therefore, been found necessary to depart from this simple form, and to shape the orifices into curves and use guide blades, so that to some extent these turbines become impulse turbines.

Morton's pressure turbines are of this class, and are of interest as showing how it is necessary to direct the flow of steam from one turbine to the next when placed in series order.

In turbines acting by difference of pressure only, the benefits derived from series working cannot be obtained on the system of expansion of the size of the orifices in each turbine as they near the exhaust end. Such expansion merely maintains the velocity of flow and reduces the pressure just where it is most wanted, that is at *c*, fig. 17. The object of the series arrangement in correct designs is to reduce the velocity of flow and still maintain the pressure.

If the inner pressure in diagram 12 is 100 lbs. per square inch, and the outer pressure atmospheric the velocity of flow will be 880 feet per second, when the pressure into which the steam flows is less than $\frac{3}{5}$ths or the initial pressure the velocity is about constant at 880 feet a second.

The object then to be attained by series arrangements is to make the pressure into which the steam flows much greater than $\frac{3}{5}$ths the initial pressure.

The initial pressure in fig. 12 is 100 lbs. per square inch, $\frac{3}{5}$ths of 100 = 60 lbs., 40 lbs. difference, a difference too great to reduce the velocity of flow appreciably; if, however, we make the pressure into which the steam flows $\frac{9}{10}$ths of the initial, $\frac{9}{10}$ths of 100 = 90 = 10 lbs. difference, and put 10 turbines in series working at a difference of 10 lbs. between each, we shall have still a

back pressure of 100 lbs. on the series as a whole, but steam will be saved, for the velocity of flow will be reduced; how this difference of pressure is to be maintained between the turbines in the series we shall find later on.

(To be continued.)

PHYSICAL SOCIETY.

Ordinary Meeting, April 21st, 1899.

Mr. T. H. Blakesley, Vice-President, in the chair.

A mathematical paper on "The Effect of a Solid Conducting Sphere in a Variable Magnetic Field on the Magnetic Induction at a Point Outside," was read by Mr. C. S. Whitehead.

It is an investigation of the magnetic induction at a point outside a solid inducting sphere when magnetic disturbances are taking place in the dielectric envelope. An expression is given for the maximum value of the magnetic induction when the sphere becomes an infinite plate, and the inducing system consists of an alternating current in a circular circuit whose plane is parallel to the plate, *i.e.*, when the maximum value of the induction tangential to the surface is zero. A second expression gives the maximum value of the magnetic induction normal to the surface for a point at considerable distance from the axis, and just outside the plate. In this latter case the maximum value of the induction tangential to the surface appears as a function of the maximum current of known frequency in the inducing circuit, the various dimensions in space of the system, and the permeability and specific resistance of the plate. From these equations, taking the most authentic values of the involved constants, the maximum magnetic induction normal to the surface for a sea-water plate is 44 times as great as it would be for an iron plate, and more than 3,000 times as great as it would be for a copper plate. The paper also shows that, for the purpose of induction telegraphy, to get the best effect the receiving coil should have its plane vertical, not horizontal, firstly, because the distance of the inducing circuit from the surface of the plate must in practice be small compared with the distance of the point from the axis, so that the maximum normal induction is small compared with the maximum tangential induction; and secondly, because the maximum *normal* induction varies inversely as the *fifth* power of the distance of the point from the axis, whereas the maximum tangential induction varies inversely as the fourth power of that distance. In conclusion, Mr. Whitehead applies his formulæ to the practical case mentioned by Prof. Lodge in the *Journal of the Institution of Electrical Engineers*, February, 1899, p. 805. Prof. Lodge there describes a horizontal receiving circuit, and states that, with no condensers in the circuit, he "was not usually able to hear anything" in the telephone. Mr. Whitehead calculates that under such conditions the theoretical value of the current in Prof. Lodge's horizontal secondary is 0·066 *micro*-amperes, but that with a vertical circuit the received current would have been 33 *milli*-amperes.

Mr. Blakesley observed that, as a rule, experiment preceded theory. He congratulated Mr. Whitehead upon having settled from theoretical considerations that the vertical position of the receiving coil is best.

Prof. Everett said that the very elaborate method of analysis adopted in the paper appeared to be very clearly stated. He would like to know whether the inducing coil ought to be vertical as well as the receiving coil.

Mr. Appleyard thought that experiment had left no doubt as to the best position of both coils. The early investigations of Mr. Willoughby Smith, and the later work of Mr. H. R. Kempe and Mr. Preece had proved that for the best effect both coils should be vertical. But large vertical coils were difficult to fix, and expensive to maintain. It was this reason, probably, that led Prof. Lodge to try what could be done with coils placed horizontally.

Mr. Whitehead, in reply, said that his formulæ only applied to a horizontal inducing coil. He had not worked out the case of what would happen if the inducing coil itself was vertical. In the Flat Holm experiments both circuits were straight wires, with their ends to earth, so that they really amounted to vertical coils.

PARLIAMENTARY COMMITTEES.

Baker Street and Waterloo Railway.

Sir Benjamin Baker was further cross-examined at the sitting of the Committee on Wednesday last week, and, in reply to Mr. Freeman, said that if the Vestry were agreeable there was no reason why they should touch the property of the Grand Hotel in connection with the Charing Cross subway.

Examined by Mr. Worsley Taylor (for the Hampstead, Charing Cross, and Euston Railway), Witness said there would probably be more traffic between Charing Cross and Paddington than between Waterloo and Paddington. It was proposed to run a three-minute service from Waterloo, the trains going alternately to Paddington and Euston.

Mr. Wheeler, Q.C.: There are a good many underground electric railway schemes in the air?—Yes; the more the better.

Further cross-examined, Witness said he could not tell how much money had been spent on property. The tunnels proposed were larger than the South London Railway tunnels. The carriages would be the same size as those of the Central London Railway. The depth at which the line would be carried varied, but the average depth was 60 feet.

The Chairman interposed, and said he did not understand that the old railway was opposed.

Mr. Wheeler said his opposition came in to the extension of time asked for.

By Mr. Coward: If the Vestry would assist the company and suggest improvements to the proposed Charing Cross subway they would try and carry them out.

The Chairman: Do you mean, Mr. Coward, that if the company is prepared to make a subway to the Post Office you are prepared to withdraw your opposition?

Mr. Coward said the Vestry objected to the Bill altogether, because the interference to traffic would be so great as they could not undertake the responsibility, but, of course, if Parliament said the Bill should pass, then they wanted to get all the advantages they could for the public.

Replying further, Witness said he would be prepared to make the subways required for the various mains at Charing Cross to the satisfaction of the Vestry. His communications to the London and Globe Finance Company certainly showed no such margin of profit to that company as had been suggested. He thought the time would shortly come when no more lines as that now proposed would be made unless the local authorities showed themselves more ready to assist them.

The Chairman: Will you make it quite clear to the Committee what will be the real cost of the line?—The cost of the Central London Railway is £585,000 per mile; of the Baker Street and Waterloo Railway, £575,000 per mile; the Great Northern and City, £652,000 per mile; the North-West London, £485,000 per mile; the Great Northern and Strand, £502,000 per mile.

Then, according to these figures, this is somewhat an average cost?—Yes.

Does that £575,000 a mile include the stations at Paddington and all the subways?—Yes.

And 14 per cent. contingencies?—Yes, all contingencies—electric lifts at stations, which do not appear in the Parliamentary estimate, drying shops, professional charges, and working capital for the company.

We understand this money is being found by a syndicate of capitalists?—As I understand, it is found by the London and Globe Finance Company. One of their directors, Lord Loch, will be the chairman of this company. Their idea is the only practical way of carrying out a railway, unless it is promoted by another railway company. It is necessary that some one should find the money for investigation, and if they are satisfied that it is a genuine concern have the pluck to put their money into it as a lead to the public. When a certain amount of money is spent the public will see it is a genuine concern.

Mr. Balfour Browne, Q.C.: And then you unload?—Oh, no; the alternative is to go on with omnibuses.

The Chairman: You will make arrangements with the vestries, so as to cause as little inconvenience to the public as possible?—Yes.

How do you propose to ventilate the railway?—There will be shafts with a number of lifts. These will be going up and down by electricity, and every time they go up they expel a great cylinder of air, and experience shows us that that is quite enough. If it requires to be aided by artificial ventilation, we could have electric fans.

But if there was a stoppage in the tunnel; we have been told that the train in motion causes the ventilation?—I went very carefully into that, for there were some alarm in consequence of a stoppage in the City and Waterloo Railway. It was said that the passengers broke the windows of the carriages. As a matter of fact, they were not in danger of suffocation, but got very hot in consequence of being penned up in the carriage with the windows closed. From calculations made it is found if a train was full of passengers in the tunnel, and both ends of the tunnel were blocked up, the passengers would die of starvation, but they would feel no inconvenience from the air.

Mr. Vigers, of the firm of Vigers & Son, surveyors, said they had purchased the land for the stations at Oxford Street, Piccadilly, and Baker Street, and had spent between £170,000 and £180,000. He thought the estimates were ample.

Lord Loch, chairman of the railway, and one of the directors of the London and Globe Company, said that when the railway was brought under the notice of the company two years ago, they instructed Mr. Vigers and Sir B. Baker to report to them, and as a result, they became responsible for the carrying out of the railway.

In cross-examination, Witness said the London and Globe Company was formed for the promotion of mines, and that was their first venture in railways. When they took the matter up for the employment of their capital, the money market was in a depressed condition.

Mr. H. Lambert, for many years the general manager of the Great Western Railway Company, gave evidence in favour of the Bill, and said there had always been a want of communication between the railways of the north and the south.

Mr. W. R. Galbraith, engineer of the undertaking, with Sir Benjamin Baker, described the proposed route and said it was necessary that they should have space for their sidings, &c., at Paddington. They could not get the space at Waterloo, because the South-Western Railway Company intended to construct another line similar to the City and Waterloo line between Waterloo and Clapham

Junction. The London and Globe Company had taken the whole of the capital. The original estimate for the railway to Baker Street and to the Sheffield line was £1,090,000, and in addition they were responsible for the equipment estimated at £215,000, the Parliamentary and professional charges, &c., estimated at £100,000; interest during construction, &c., £160,000, and working capital, £50,000. That made £1,615,000, and so if the London and Globe Company issued the whole of the stock at par they would make a profit of about £150,000, or 10 per cent.

The committee adjourned, having expressed their intention of visiting the proposed Charing Cross subway.

On Thursday Lord Loch, the chairman of the railway company and one of the directors of the London and Globe Finance Company, was called on the suggestion of the chairman, and was examined as to the financial position of the company.

Mr. Page: Are you satisfied that this line will be made in a reasonable time in the event of the public not subscribing?—Quite satisfied.

Are you also satisfied that there is a likelihood of this company being a financial success?—Yes.

Do you think if the public do not support this, the London and Globe Finance Company will be quite able to?—Yes.

Mr. W. R Galbraith was recalled with regard to a plan which the St. Martin's Vestry had submitted, to have a subway from the Grand Hotel to the post office in the Strand. Witness said that the subway could not be constructed as shown on the plan, because there was a large sewer which was on a level with the subways.

The various counsel having addressed the Committee against the Bill, the Committee adjourned.

On the Committee resuming on Friday, Sir T. G. Fardell, M.P., gave evidence against the Bill on the ground that the railway would have a very detrimental effect on the neighbourhood of Paddington, and would tend to depreciate property there. He stated, however, that he would not object if the line were to stop at Paddington Station.

Lieut.-Gen. Laurie, M.P., and a member of the Paddington Vestry, gave similar evidence, as did Mr. F. Dethridge, the Vestry clerk, who said that the inhabitants of Paddington were dead against the proposed terminal station for the new railway.

Mr. Littler, Q.C., then opened the case on behalf of the Metropolitan Railway, who are opposing the Bill, and called Sir John Wolfe Barry, who said he was the consulting engineer to both the Metropolitan and the District Railways. He did not think there was any need for the extension of the electric line to Paddington. In his opinion, the proposal to connect with Paddington and Euston was undoubtedly intended to abstract traffic from the Metropolitan system. The two lines would run parallel for some distance. It had always been intended that the Baker Street and Waterloo line should be a north and south line; but this was an attempt to make it an east and west line. The proposed communication with the Great Central terminus would be accommodated by an already authorised line, while as to Euston that would be served by the projected Hampstead, Euston and Charing Cross Railway. For nearly a mile the new railway would be within 200 yards of the Metropolitan Company's inner circle. The net result of their proposals was that they would get a railway two miles long parallel with the Metropolitan Railway Company and in direct competition with it—a position which he had never known sanctioned except where the existing line had failed in its duty to the public. The witness then proceeded to give details as to the trials which were to be made with electricity on the Metropolitan and District lines. Both those companies, he said, had voted £10,000, which had been placed at the disposal of himself and Mr. Preece for the purpose of ascertaining whether the Metropolitan traffic full-sized trains could be successfully worked by electricity, under all the conditions of the Metropolitan rolling stock, between Kensington Station and Earl's Court. He believed that was the first real practical trial of electrical traction for full-sized stock there had been in this country. They were erecting a small dynamo near Earl's Court, and were laying conductors on the rails to Kensington Station, and he hoped that in about four or five months they would have a train running. The object of the experiment was not to convince Mr. Preece or himself of the practicability of working the Metropolitan service electrically, because they were thoroughly convinced of that already, but before they made such a large change on so important a railway as the Metropolitan or the District, they had determined to thoroughly satisfy themselves that they had got the best kind of rolling stock and the best kind of conductors, and that they should gradually habituate the employés and staff to the electrical mode of traction. When electrical traction was substituted for the present method, the lines would be able to accommodate about a third more than the present number of trains. The substitution of the new rolling stock and the provision of the generating station would entail very heavy expenditure, but he was thoroughly convinced it would eventually result in economy.

Mr. W. H. Preece gave evidence of a similar nature, and said that as a result of adopting electrical traction, the tunnels of the two company's would be freed from foul air and the increase of temperature in the tunnels of 10° or 12° would be done away with. The present mean rate of travelling on the inner circle of 11·2 miles an hour would be increased to at least 14 miles, and the present time occupied by the journey round the whole inner circle would be reduced from 70 to less than 50 minutes. That would make it possible to add eight new trains to the service and increase the traffic capacity of the line by 35 per cent.

Then Committee adjourned.

Further consideration was given to the Bill on Tuesday by the Committee, presided over by Mr. Jeffreys.

Mr. Littler, Q.C., addressed the Committee on behalf of the Metropolitan Railway Company, against the Bill, and contended that the whole scheme was a sham being promoted by the London and Globe Corporation. He considered that it would be unfair to allow the extensions to Euston and Paddington to compete with the Metropolitan Railway, which was going to large expense in experimenting in electrical traction, and which would enable that railway to better meet the demands of the traffic.

After a private consideration, the Chairman said the Committee had decided not to allow the extensions to Paddington and Euston asked for, but they would give an extension of time for the completion of the works, provided that the company constructed a subway from the Charing Cross Post Office to their station and another subway to Spring Gardens as arranged with the London County Council. They would grant the small line to the Strand which the company required, and give the company power to take a portion of the roadway near the Grand Hotel, so as not to interfere with that property.

Great Northern and Strand Railway.

A Select Committee of the House of Commons, under the chairmanship of Mr. A. H. Brown, sat on Thursday for the purpose of considering the Bill of the Great Northern and Strand Railway. Mr. Balfour Browne, Q.C., Mr. Fitzgerald, Q.C., and Lord Robert Cecil appeared for the promoters, and various counsel appeared for the opponents, who included the Strand District Board of Works, the London County Council, St. Giles's District Board of Works, the Great Northern and City Railway, the Duke of Bedford, St. Pancras Vestry, the Metropolitan Railway Company, and the Metropolitan Electric Supply Company.

Mr. Freeman said it was proposed that the railway should follow the same course as the proposed new street of the London County Council from Holborn to the Strand. The Council wished that the line should be constructed so as not to interfere with their proposal, which would have to be considered by the Committee after this Bill was disposed of, and he asked that the Committee should reserve their decision until they had considered the Council's Bill.

Mr. Browne said they did not propose in any way to prejudice the new street, and, in fact, to a certain extent, their scheme was dependent on the new street, for while the railway would have been brought to Holborn, they would have hesitated to have proceeded to the Strand had it not been for the proposed new street.

The Chairman intimated that the Bill had better be proceeded with.

Mr. Balfour Browne said he did not hesitate to say that this was one of the most important Bills that had ever been promoted in the interests of the traffic of London for a very long time. The Bill was to empower a railway to be worked by electricity from Wood Green to the Strand. The line would consist of four separate railways. The first would be from Wood Green to Finsbury Park, and would be 1 mile 3 furlongs and 9·5 chains in length. No. 2 railway was from Finsbury Park to King's Cross, and the whole of that section would practically be beneath the present line of the Great Northern Railway Company. Under these circumstances, as they were affiliated with the Great Northern Railway, they would get from Wood Green to King's Cross practically without any expense for the purchase of land. At the same time they had to be at very considerable expense to construct a tunnel which would be strong enough to bear the Great Western Railway, and they must construct it in such a way as not to impede the traffic of the Great Northern Railway. This proposal was somewhat like the proposal made by the Metropolitan Railway to construct a deep level electric line under their existing line, and this was a proposal which Parliament had sanctioned, although the want of capital had prevented it being carried out. From King's Cross to Holborn they would have to go under private property at a very great depth, and they would have to pay for the easements they took under private property. Practically, to this point, there was little opposition. From Holborn, where they crossed the Central London Railway, they proposed to utilise the subsoil of the new street to be constructed by the London County Council until they came to their proposed terminus in the Strand. There was not the least difficulty in making the railway in such a way so as not to interfere with the proposed street of the County Council. The total length of the line would be 6 miles 2 furlongs and 7 chains, and would cost £2,287,903. It was promoted separately from the Great Northern Railway, but Mr. Jackson, the chairman of the Great Northern, and three other directors of that railway would be on the board. There was no question as to the ease with which the capital could be raised, and, in fact, no question of finance was raised by the opponents. The railway was simply for passengers, and they did not propose to carry goods. The capital provided by the Bill was £2,400,000, and the proposed borrowing powers £800,000. The borrowing powers would be used for the equipment of the line. The cost of the line would thus be £381,317 per mile. With regard to the necessity of the line there could be no question, for the congestion of the London streets was becoming a pressing matter. The Great Northern Railway Company felt itself unable to adequately deal with the enormous suburban traffic, and the new line would be of immense assistance in coping with it. The Northern and City Railway which was to be constructed was practically doing for the City what the Great Northern and Strand Railway proposed to do for the Strand, and he understood that they did not oppose the preamble of the Bill but only a clause. The street scheme of the London County Council did not depend on their railway, and he thought that really they welcomed the railway. He contended that there was no real opposition to the Bill, although there might be criticism.

Sir H. Oakley, general manager of the Great Northern Railway, was called in favour of the Bill, and said in reply to Lord R. Cecil that if carried out the proposed railway would afford immense relief to

the traffic of London. It was intended to run trains at frequent intervals—possibly 2½ minutes." . . . He had no doubt that the line would be greatly used, and he expected that there would be a return of 3 or 4 per cent. on the capital invested.

Other evidence of a similar character was called.

Mr. Charles Steel, general manager of the Great Western Railway, said the Bill had been framed in consequence of the enormous congestion of traffic on the Great Northern line. Notwithstanding that a great sum of money had been spent on the widening of the Great Northern line the congestion was becoming worse. It was estimated that they would carry 6,000,000 or 7,000,000 passengers a year on the new line.

In reply to Mr. Talbot (representing the London County Council), Witness said that if the new street from Holborn to the Strand was not made the proposed section of the line from Holborn to the Strand would fall through.

Mr. Alex. Ross (engineer of the Great Northern Railway) said it was proposed to have stations at Wood Green, Hornsey, Harringay, Finsbury Park, Holloway, Bingfield Street, King's Cross, Holborn, and Wych Street. The line would be built at various depths from 41 feet to 110 feet. There would be lifts at the various stations.

Mr. Galbraith was also called, and stated that he had approved of the plan after careful examination. There would be no danger to private property as the line would pass at a great depth below private property.

Mr. Freeman, Q.C., replying on the evidence of the County Council, said it was not contended that the railway would not be a public advantage, but his clients ought to retain the subsoil of the new street, which they were buying with hard cash.

The Committee decided that the preamble of the Bill was proved, and postponed the consideration of the clauses till the following day.

CORRESPONDENCE.

Electric Piping.

The thanks of the electrical profession are certainly due to you for calling attention to the electrical wiring question in your interesting article under the heading of "Electric Piping." It is to be hoped that consulting engineers and others with a thorough knowledge of the matter gained by experience will avail themselves of your invitation to discuss this subject in the columns of the Review.

No doubt the electrical wiring industry has been much hampered in England by a multiplicity of conflicting rules and regulations, and the conscientious contractor who undertakes to wire a building, in some cases in accordance with three distinct sets of regulations, has found himself in a somewhat untenable position.

As you very pointedly observe, Continental and American practice is almost entirely in the direction of iron and steel conduit, whereas in England, on account of grandmotherly enactments, petty bye-laws, and unreasonable restrictions, work is still largely being carried out on the antiquated methods of wood casing, compo pipes, or lead sheathing.

Surely the first step towards the simplification and uniformity of wiring rules is that engineers should be agreed on the necessary requirements of an interior wiring system, and with all due respect to a high authority, the rat-tight, gas-tight, and water-tight arrangements can hardly be taken seriously by practical engineers.

The function of an interior conduit is to afford an efficient mechanical protection to the interior circuits, to preserve their insulating properties in a satisfactory manner, and the conduit itself must of necessity be durable and inexpensive in first cost and erection. These appear to be broadly the necessary requirements as distinct from mere advantages possessed by certain systems, such as lightness, compactness, simplicity in handling and fixing, &c.

A conduit which is to afford complete mechanical protection must necessarily be metallic, and when cost is a consideration we are at once restricted to iron or steel. By using steel we may reduce the gauge, and so lessen the expense, always providing that an ample margin be left so that in the event of an accidental arc occurring in the conduit the circuit fuse would blow before the heat generated could raise the temperature of the tube to any harmful extent.

To prevent deterioration, and also to provide a smooth interior, the tube should be enamelled, or coated with some other preservative substance.

Certain enamels possess an insulation resistance of some thousands of ohms for a film of but a few mills in thickness, but the insulation is not to be relied on owing to slight inequalities in the distribution of the enamel, nor is there any reason why this insulation should be necessary, as, if we start from the standpoint of a well-insulated cable, the function of a conduit should be, as previously pointed out, to maintain that insulation and to preserve it from mechanical injury, but not to increase it. The running of well-insulated cables in insulated pipes is somewhat analogous to running vulcanised rubber cables on insulators in copper strip culverts, a procedure which would nullify the object of their existence.

To preserve the insulating properties of cables in an efficient state it is necessary to secure a smooth and even interior surface, both for the conduit and for the accessories for safety in drawing through.

Many engineers specify that a conduit system shall be water-tight, and no doubt if there were no such thing as condensation, this would be an ideal system. It is, nevertheless, practically speaking, an unattainable ideal, and there is no doubt that moisture due to sweating and internal condensation, which, collecting at certain, and usually the most vulnerable parts of the system, is much to be feared, and will often be the cause of endless trouble unless due provision be made for its exit.

With regard to expense, in this we must consider the cost of a system erected. Wood casing is most deceptive in this respect, as the labour involved in well-finished work is out of all proportion to the actual cost of the casing, which naturally appears very low.

About 12 months ago the Simplex enamelled steel conduit system was put on the market, the system had been very thoroughly worked out in detail, and it was expected to compete with wood casing on the ground in which that material had hitherto held the field, namely, cost of system erected, and there is abundant evidence to show that in this the expectations have been fully justified.

Owing to my connection with the company, my remarks will no doubt be regarded as biased in its favour; but after all, the proof of the pudding is in the eating of it, and up to the present the "Simplex Steel Conduit Company's" system has fully justified its existence.

The company has lately succeeded in securing, in open competition with most of the Continental and American systems, what probably is the largest order for conduit for a single installation that has ever been placed on the Continent, amounting to, in all, some hundred thousands of feet of tubing. A list has also been published containing the names of over 100 of the more important installations where the Simplex system has been erected during the first three months of this year, and our returns go to show that at the present time there are considerably over 1,000 installations in the course of erection on this system in Great Britain. In the majority of cases the contractors who have used our system have had to compete against wood casing, and they have done so, and continue to do so successfully and repeatedly.

In the advancement of our business we have not found it necessary to depreciate the value of others, although advertisements emanating from a well-known firm of conduit manufacturers have appeared at least in one of the electrical papers, showing some distorted and impossible situations where our conduit and fittings were placed to their detriment; however, this advertisement appeared for a short time only, as probably it did not have the desired effect, and happily the policy of belittling the manufactories of a competing firm in order to boom one's own goods is not one which finds much favour in England.

Although at first the Simplex system encountered much opposition, which was chiefly directed to the longitudinal seam in the tube, as it was looked upon as a *sine quâ non* of a conduit system, that it should be so-called water-tight, despite the fact that wood casing, which had to all intents and purposes been in use since electricity became a commercial commodity, was not only not water-tight, but actually harboured moisture to a dangerous extent, this opposition has now happily greatly subsided, the results obtained by practical experience under the varying conditions of surface work, plaster and cement, having proved more convincing than all theoretical deductions, and most of our former antagonists are now our best supporters. The system has recently undergone considerable development in that it is now completely metallic throughout, and in this connection

the company is much indebted to fire insurance inspectors, consulting engineers, architects and contractors for many valuable and practical suggestions; these new fittings and accessories are now being exhibited at the company's stand in the electrical section of the Agricultural Hall Exhibition, Islington.

In conclusion, I may with advantage quote a statement attributed to one of our prominent station engineers, where, after making light of the "fire bogey," but condemning wood casing on the question of durability, harbouring moisture, &c., goes on to say:—"It would do a great industry much harm if exaggerated ideas about the danger of fire got abroad, and after all, the real question is, How to make the outside protection of wires permanent? The main point is the question of price, and it is useless reducing the price of electricity per unit if the cost of wiring is to be kept up to £1 a light."

This statement, I submit, touches the root of the wiring question, and is well worthy of the consideration of the committee who is to draft the new wiring regulations.

L. M. Waterhouse, A.M.Inst.C.E. and E.E.
The Simplex Steel Conduit Company, Limited, Birmingham and London.

I should like to offer some remarks on your interesting series of articles on "Electric Piping," especially as some tests have recently been made on it in the electrical laboratory here under my direction. With regard firstly to the resistance offered by the joints: You state quite correctly that "the total increase of resistance due to the resistance of the joints in an ordinary run of, say, 50 feet, with a joint every 8 feet, is only about one-half per cent., which is practically negligible." Suppose we allow a drop of 2 volts from the main switch to the farthest lamp in the building, and consider that 1 volt is dropped from the main switch to the distribution board, and that 1 volt is dropped in the 50 feet run of piping from the distributing centre, then the drop due to the extra resistance of the joints in this run will be one-half per cent. of this, that is, ·005 volt. Taking your view that it would be quite legitimate to double the above number of joints to allow for bends and boxes the drop in volts due to the extra resistance of the joints would only be 1 per cent. of 1 volt, that is, ·01 of a volt *and not* 1 *volt*, as the wording of your article might lead readers to suppose.

It was found that the joints could be easily tested *in situ* by means of a direct reading milli-voltmeter, and any joint which is not properly screwed home, and has therefore an abnormal resistance, can be at once detected. With reference to the insulating lining of the pipes being non-hygroscopic, a square inch of the lining material 50 mils. thick, after being dried in a steam oven, was exposed to the air for 12 hours, and gained ·0026 of a gramme in weight, due to the absorption of moisture; this is equivalent to a gain of ·24 per cent. by weight. I cannot say off-hand how this compares with other insulating materials of a similar character, but I hope to be able to give you some further information next week on this point as well as the insulation resistance of the conduit under various conditions.

Alfred Schwartz.

South-West Polytechnic Institute,
Chelsea.

The Niclausse Boiler.

In an article upon the Niclausse water-tube boiler in the last number of the Electrical Review, you ask whether it was in the French cruiser *Friant*, which is furnished with Niclausse boilers, that a tube split open and caused the death of several men? Allow me to answer the question. No such serious accident has ever happened in the *Friant*; I think your reference is to an accident in another ship of the French Navy, fitted with another type of water-tube boiler. In the *Friant* a tube once split open, but no such serious result followed; I think one man was injured but slightly. Mons. Bertin, at page 353 of the English translation of his book on "Marine Boilers," says only: "Since the reception trials a boiler in the *Friant* has had a slight mishap, through a badly welded tube."

Notwithstanding this, Messrs. Willans & Robinson, Limited, the English makers of the boiler, are quite in agreement with you that solid-drawn tubes should be used. For reasons which need not be entered into, the use of welded tubes in water-tube boilers has been common until recently, but the action of the English Admiralty in changing to weldless tubes is entirely to be commended, and so far as regards the Niclausse boiler, of our manufacture at least, no others are likely to be used.

As your article is practically a criticism upon a paper read by me before the Institution of Naval Architects, will you allow me to point out that the paper was read nearly four years ago, when our experience of the boiler was limited to tests of one small boiler sent over from France. I am still of opinion that it was a remarkable achievement to make two steam-tight joints on the two opposite sides of the header, the tube passing through both. Considering the changes of temperature, and the fact that one side of the header was to be definitely hotter than the other, I venture to think it was not a foregone conclusion that even the good workmanship of Messrs. Willans & Robinson, which you are so kind as to compliment, would ensure tightness. Success was achieved by the expedient of making one of the two cones elastic, virtually a cup-leather in malleable cast-iron, and I really do not think my paper spoke too strongly of that ingenious expedient, which naturally had then for us a novelty which it has ceased to possess. The form of the joint, and the material, may be changed, but the principle of making one of the cones elastic will not be departed from. With regard to the remarks in my paper that the trials were made without auxiliary air supply, may I point out that this was an important question at the time, and that, in fact, it has, at least until lately, been considered desirable to give such an air supply in the Belleville boiler, even when burning Welsh coal. It is forced in by an air-compressor at considerable pressure, and the fact that the Niclausse boiler gave good results without this comparatively costly addition was, I still think, a fact of some importance.

Mark Robinson.

Victoria Works, Rugby,
April 24th, 1899.

Signalling on Single Line Railways.

With reference to your article on the above subject dealing with the modifications effected by me in electric tablet and train staff apparatus for non-passing stations on single lines of railway, the writer of your very able article upon this question is quite correct in assuming that the press button or key and battery shown is for the purpose of releasing, and so avoiding delay, in case of failure of the outer treadles, until the telegraph lineman arrives and puts the apparatus right. I ought, of course, to have mentioned this, and also the fact that the key or button is in a small locked-up box, with a paper front containing instructions as to its use, *and bearing a consecutive number*. Such paper when torn to get at the key can only be replaced by the telegraph lineman, who is compelled to return such torn paper bearing its proper number, attached to his fault report. A record is kept of the numbers, and this device is in a great measure an effective check on the use of this press button or key. The writer of your article is also right in assuming that the batteries are all purposely put near to each rail contact instead of in the signal cabin, to avoid accidental releasing through the wires getting earth between cabin and rail contact.

Do I understand the writer of your article to say that a safe, reliable, and effective alternative method has been devised for dealing with non-passing stations by merely breaking the lines so as to prevent acceptance of trains whilst any one signal is in the "off" position? If so, I am sure every railway officer would be glad if the writer of this article would favour us with a diagram and further particulars.

F. Hollins.

Wireless Telegraphy.

In reply to your correspondent, A. C. Nash, Signor Marconi took out a patent in 1896 in England and various other countries with claims of such a comprehensive

character that he would practically have a monopoly of spark telegraphy if the whole of them could be upheld in the Law Courts. It is astounding that his legal advisers could have allowed him to make some of these claims if they had even a moderate knowledge of what had been done by others at the time, but it would be still more astonishing if they tried to uphold them in a patent action. It is doubtful, to say the least, if Signor Marconi could, by amending his patent, substantiate the one all-important claim to which, in the opinion of most people, he has a moral, if not a legal, right, viz., the use of the high wire.

Although Signor Marconi speaks in a very confident way of the particular form of coherer, choking coils, &c., he has devised as essential for success over long distances, no one who has worked at the subject attaches much importance to them. Nothing is really essential that is in any way a speciality of his except the high wire. He was the first to prove the great advantage of this by practical demonstrations on a large scale and is entitled to the credit he has obtained. His company has been to great expense, and deserves to benefit financially, but no patent has been granted to it for the sole use of the ether for transmission of Hertz wave telegrams as the daily papers seem to suppose.

Hertz Wave.

The Bristol Switchboard Specification.

I venture to offer a few criticisms upon Mr. Proctor's specification for a new switchboard for Bristol, tenders for which have been lately invited.

Mr. Proctor has thought it right not only to specify his requirements in outline, but has submitted detailed drawings of almost every part of the board.

Where he has not submitted drawings he has defined the space available for the fitting, and in this way in general precluded manufacturers from using any of their standard designs.

The first result of this specification is that the Bristol Corporation will be saddled with the cost of the preparation of these drawings by their engineering staff, and the cost of the shop working drawings, patterns, jigs, templets, &c., necessary to enable the contractor to construct the board.

In my opinion Mr. Proctor could only be justified in taking such a course if he were unable to obtain among the standard designs of manufacturers apparatus which would reasonably fulfil the requirements at Bristol.

I most certainly consider that Mr. Proctor's designs are not in any single respect in advance of designs already on the market, and in many respects I think that they are inferior.

To give two illustrations—a design of an 800-ampere 2,000-volt switch is given. This switch has a total break of 6 inches. It may be that it is not intended to operate this switch at full load, but firms tendering are required to submit a detailed drawing of the 400-ampere H.T. switches of similar design. It is true that it is stated that an alternative design would be considered; but it is specified that the switch shall be double break, and the space available is so limited that a sufficient and efficient double break can hardly be provided.

Again, the manner of insulating the panels, bus bars, &c., is either specified or drawn in detail. In the case of the bus bars there is a total creepage ebonite surface of $\frac{1}{4}$ inch to slate and another $\frac{1}{4}$ inch slate to earth. It is then specified that the insulation shall withstand a pressure to earth of 8,000 volts for one hour. This insulation is not, in my opinion, sufficient, but whether it is sufficient or not, Mr. Proctor should take the reponsibility of his own designs.

There is another direction in which Mr. Proctor appears to shirk responsibility which should properly rest on his shoulders. He designs the resistance frames, specifies the energy to be dissipated by them, and designs in detail the space to be occupied by these resistances. He then further specifies that their *temperature shall not rise so as to be dangerous to the surrounding cables or other works when carrying full exciting current.*

I trust that Mr. Proctor will read these remarks, if they meet his eye, in the spirit in which they are written. There is no personal feeling whatever in the matter, but only a desire to protest against a system which is essentially so uneconomical. We talk so much about "standandisation" and do so little.

Engineer and Ratepayer.

Installation Estimates.

Can you, or any of your readers, tell me through the medium of the Review, whether or not there are any works published on estimating for installations, &c.? If so, their titles and by whom published?

Thanking you in anticipation.

Subscriber.

[There is a chapter on "Costs and Estimates for Wiring" in Mr. H. M. Leaf's book, "The Internal Wiring of Buildings," but we do not at the moment recall any special work devoted to the subject. Possibly some of our readers can give the desired information.—Eds. Elec. Rev.]

Paper Telephone Cables.

In reply to Messrs. O'Gorman & Cozens-Hardy, I must say I am surprised that my statement of the capacity of paper cables was not taken as I intended, *i.e.*, as the result of an average test of an average cable, a 306 or a 408 wire. Anyone who knows anything at all about cables would not for one moment suppose that the capacity of a 612 wire cable would be the same as that of a 408 wire which is of the same diameter. The capacity of the large cables is not, however, so much higher than that of the smaller ones, not being above 0·087 microfarad per mile, as against 0·085 microfarad per mile for the smaller ones. These are the results of a number of tests of cables which have been laid in the ground. The overall dimensions given by me are not wrong, as stated by Messrs. O'Gorman & Cozens-Hardy.

By an oversight the word "thousand" was missed out; the working insulation should have read six to fifteen thousand megohms per mile. The insulation resistance of a cable may be anything from 200,000 megohms downwards, according to the amount of moisture in it. Therefore, statements as to insulation resistance will, of necessity, vary.

E. J. J.

April 25th.

Correspondence.—We have received letters on "Interior Conduit Wiring" from W. H. Isherwood and J. G. Burchell. Pressure upon our space compels us to hold these over until next week; also a letter by F. C. Wilson on "Two-phase Motors."—Eds. Elec. Rev.

LEGAL.

Jandus Arc Lamp and Electric Company, Limited, v. Beanland, Perkin & Co.

On Saturday, April 22nd, in the Chancery Division of the High Court of Justice, before Mr. Justice Stirling,

Mr. J. C. Graham, who appeared for the plaintiffs in the above action, moved for judgment in default of pleading. Counsel said the action was one for restraining the defendants from infringing three patents for arc lamps, which patents were plaintiffs' property. There had been no defence put in by the defendants, and Mr. Graham said that the only judgment he should ask for was an injunction, without costs or any inquiry as to damages.

His Lordship said he would grant the injunction as applied for.

The Electric Organ Company, Limited.

In the Chancery Division on Saturday, before Mr. Justice North, Mr. Kerley moved for the appointment of a receiver in the matter of the Electric Organ Company, Limited, of Norwich, on the ground that the debentures were in jeopardy. Counsel stated that the company were unable to pay their debts, the company having lost £27,000, and some of the creditors were now in a position to issue execution, thus placing the securities in danger. The matter was an urgent one, and he asked that the Official Receiver of the Norwich Court should be appointed receiver. There was no opposition on behalf of the company, and his Lordship made the order asked for, with leave to act at once, subject to affidavits of fitness, and the completion of the security forthwith.

The Electric Exploitation Company.

In the Companies' Winding-up Court of the High Court of Justice on Wednesday, April 26th, Mr. Justice Wright, sitting as an additional judge of the Chancery Division, had before him the petition of the Sussman Electric Miners' Lamp, Limited, who asked for an order for the compulsory winding up of the Electric Exploitation Company, Limited. Mr. Hamilton appeared in support of the petition, which was opposed by Mr. Dill.

Mr. Hamilton said the petitioning company lent to the other company on March 18th, 1897, the sum of £600, which was to carry interest at the rate of 10 per cent. per annum, and to be repayable upon demand. As security for the loan the company deposited with the petitioners debentures to the nominal amount of £600, and also some thousands of deferred shares in the petitioning company. Demand had been made for the repayment of the loan, but the amount had not been forthcoming.

Mr. Dill said he had two points to make in resisting the petition. In the first place, the petitioning creditors owed his clients a debt considerably in excess of the debt owing to them for the price which the petitioners had received for the sale of some patents in a process to which the Exploitation Company had the right to one-third. Again, if a compulsory order was made nothing would be gained, as there would be no assets to wind up. As to the shares in the petitioning company, they were practically valueless. At any rate, they were not worth more than 2d. per share.

Mr. Justice Wright observed that even 2d. per share on several thousand shares would produce a certain amount of money.

Mr. Hamilton disputed that the shares in the petitioning company were valueless. As a matter of fact, it was always difficult to say what would be the ultimate value of patents, but he was instructed that these shares were likely to be of considerable value. As to the share of the Exploitation Company in the patent process which had been disposed of to a Belgium Company that had not yet become due, and could not, therefore, be treated as a debt.

In the result his Lordship made a compulsory order as asked for.

BUSINESS NOTICES, &c.

Awards.—At a scientific and industrial exhibition held in Coatbridge Town Hall, Messrs. McAuley, Clark & McLaren, Glasgow, have obtained a Gold Diploma for a water-tight system of electric light wiring. Messrs. Anderson & Munro, also of Glasgow, have received a similar award for their electric appliances and machinery.

Bankruptcy Proceedings.—A sitting of the London Bankruptcy Court was held last Friday for the public examination of Noah Mitchell, electrical belt maker, Regent's Street, W., who applied to pass upon accounts showing debts £758 17s. 9d., and assets *nil*. The debtor in 1888 married Mrs. Pulvermacher, who carried on business as a manufacturer of galvanic appliances at 194, Regent Street, under the style of J. L. Pulvermacher & Co. He acted as foreman and manager of that business, and when in 1897 it was converted into J. L. Pulvermacher & Co., Limited, he was appointed as manager of the company. In the course of his evidence the debtor said his failure was caused entirely by the adverse result of an action brought against him for the recovery of a valuable watch which was given to him as an agency commission. Three-fourths of his liabilities related to that dispute. The examination was concluded.

At Brighton Bankruptcy Court last week Mr. Samuel William Paine was publicly examined. Debtor, an electrician, of Gloucester Road, Brighton, commenced business in 1893, entering into partnership without capital, but with about £70 worth of stock. After two years the partner took over the business, debtor becoming a journeyman. In August last year he again commenced business, and during eight months his takings were £265 and his expenses £276. He had a claim of £138 against a former employer, who, however, laid a counterclaim of £108 for rent and petty cash. Debtor denied receiving a cheque for £30 or £250 for apprentices since he had been in business. He also denied removing any fittings or fixtures. The examination was closed.

The creditors of James Edwin Stott, of Wood Street, Huddersfield, electrician, trading as James E. Stott & Co, met on 24th inst., at the office of the official receiver (Mr. J. A. Binns), Huddersfield. The gross liabilities amount to £731 1s. 3d., and the estimated deficiency is £323 16s. 6d. Mr. T. Herbert Kaye, Huddersfield, was appointed trustee with a committee of inspection.

Liquidations, Dissolutions, &c. — The Automatic Electric Meter Syndicate, Limited, resolved on March 30th, to wind up voluntarily, Mr. Gordon Saies being appointed liquidator.

The Lithanode Electric Storage Company, meeting at St. Helen's Place, E.C., resolved to wind up voluntarily, Mr. H. F. Pollock and J. M. Richardson being appointed liquidators.

Creditors of Messrs. Mather & Platt, Limited (1892), must send particulars of debts, &c., as at June 30th, 1898, to Mr. John Mather, 8, King Street, Manchester, the liquidator, by May 31st.

Messrs. W. H. Holmes, A. Holmes, J. H. Holmes, L. W. Holmes, and E. Holmes have dissolved partnership so far as regards W. H. Holmes. The business of J. H. Holmes & Co., electrical engineers, Newcastle-on-Tyne, will be continued under the old style by the remaining partners.

Last week the Shropshire Electric Light and Power Company, Limited, whose undertaking has been purchased by the Shrewsbury Corporation, resolved to wind up voluntarily, and appointed the secretary (Mr. Naunton) liquidator for the purpose.

Electrical Wares Exported.

Week ending April 12th, 1898.

Albany	Value	£15
Amsterdam	Value	100
Antigua.	Teleg. mat.	16
Calcutta		56
Cape Town		1,102
Delagoa Bay		16
Durban		201
Gothenburg		24
Hong Kong		812
La Plata		12
Lisbon		75
North Atlantic.	Teleg. cable.	11,520
Port Elizabeth		218
Sydney		653
Wellington		100
Total		£14,958

Week ending April 11th, 1899.

Amsterdam	Value	£20
Boca		15
Bombay		140
Buenos Ayres		1,337
"	Teleg. mat.	160
Calcutta		321
Cape Town		508
Copenhagen		49
Durban		847
East London		3,461
Hamburg		110
Hong Kong		182
Lisbon.	Teleg. mat.	80
Madras		196
"	Teleg. mat.	134
Malta.	Teleg. instruments	1,450
Melbourne.	Teleg. mat.	773
Nelson.	Teleg. mat.	115
Ostend		35
Port Elizabeth		110
Shanghai		295
Singapore		20
"	Teleg. mat.	69
Stockholm.	Teleg. mat.	355
Sydney		885
"	Teleph. mat.	106
Trinidad		13
Wellington		182
Yokohama		390
Total		£12,352

Week ending April 19th, 1898.

Albany.	Telep. mat. Value	£80
Alexandria		34
Amsterdam		120
"	Teleg. wire	30
Auckland		29
Bangkok		122
Barcelona		41
Batoum.	Teleg. mat.	180
Beira.	Teleg. mat.	1,155
Bombay.	Teleg. mat.	50
Boulogne		139
Buenos Ayres		220
"	Teleg. mat.	350
Calcutta		337
Cape Town		2,160
Colombo		308
Copenhagen		55
Delagoa Bay		500
Durban		423
East London		255
Genoa		70
Geraldton		80
Hamburg		110
Hong Kong		28
Madras		891
Melbourne		169
New York		150
Ostend		50
Port Elizabeth		1,723
Rockhampton		9
Rotterdam.	Teleg. cable	16
Santander		28
Shanghai		1,030
Singapore		150
"	Teleg. mat.	25
St. Petersburg		50
Stockholm		275
Sydney		120
Tientsin		11
Townsville		67
Valparaiso		167
Wellington		326
"	Teleph. mat.	2,847
Yokohama		487
Total		£15,007

Week ending April 18th, 1899.

Aden.	Teleg. mat. Value	£50
"	Telephones	100
Alexandria		74
Amsterdam		54
Antwerp		27
Ballek Pappen (Java).	Teleg. cable	290
Bangkok		11
Bombay		88
"	Teleg. mat.	133
Boulogne		18
Buenos Ayres		906
"	Teleg. mat.	441
Calcutta		524
Cape Town		1,267
Durban		486
East London		33
Genoa		70
Hong Kong		45
Launceston		15
Madeira		29
Madras		11
Malta		54
Newcastle (N.S.W.)		480
Ostend		81
Port Elizabeth		1,064
Rio Grande do Sul		30
Santos		140
Shanghai		50
Singapore		10
"	Teleg. mat.	69
Spezzia		245
Stockholm		425
Sydney		1,673
"	Teleg. mat.	635
Tientsin		11
Wellington		65
"	Teleg. mat.	1,715
Yokohama		178
Zanzibar.	Teg. mat.	26
Total		£11,577

Foreign Goods Transhipped.

Yokohama	£240	East London. Elec. lgt. fittings	£416

Books Received.—"Fortschritte der Angewandten Elektrochemie und der Acetylen-Industrie im Jahre, 1898," by Dr. Franz Peters. Arnold Bergsträsser Verlagsbuchhandlung (A. Kröner) in Stuttgart.

"The Commercial and Business Aspects of Municipal Electricity Supply," by Alfred H. Gibbings. Published by the author in Bradford. 15s.

"The Tall Building under Test of Fire," by H. de B. Parsons (illustrated). British Fire Prevention Committee, London.

"Fire Tests with Floors." Particulars of experimental fire test. The British Fire Prevention Committee, London. 1s.

Catalogues, Lists, &c.—Messrs. P. R. Jackson & Co., Limited, have sent us a copy of their complete catalogue just issued. It is an excellent one in every respect. The printing and paper are of the first order, and the illustrations very plentiful. It is divided off into various sections, viz: Section A is devoted to gear wheels, fly-wheels, iron and steel forgings, castings, &c., a number of pages giving in tabulated form sizes and other details of patterns for machine-moulded worm-wheels. (B) deals with pistons and rings of various sections. Electrical plant and apparatus have 20 sections set apart for them, dynamos and motors for different purposes and of various types, electric haulage, lifting, winding, and pumping machines being among the numerous lines which are described, illustrated, and dimensioned. There is a good deal of letterpress matter of a general electrical kind possessing considerable interest, and this gives a special value to the book. We have not space to mention all the items in detail, but special reference should be made to data regarding cost of installing and working electric generating plants for

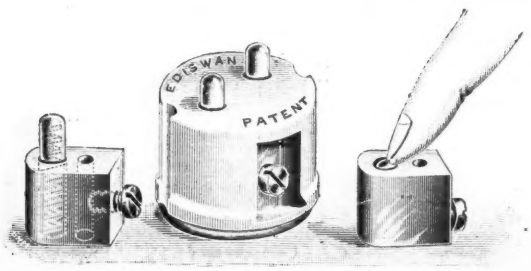
ligh'ing and power, comparative cost of gas and electric lighting, notes on electrical engineering and the selection of electrical machinery, this last-mentioned being illustrated by a number of simple diagrams. There are notes on the care and working of dynamos, motors, and arc lamps, instruction for erecting and working accumulators, and tables and useful data which the electrical engineer requires at his finger ends. We understand that the electrical and mining sections, which, it will be seen, contain much information which may be useful to the non-technical buyer as well as to the electrical engineer himself, have been compiled by Mr. W. F. Jones, A.M.I E E, M I.M.E. A large number of views are given in the book of various departments and shops at the works at Salford Rolling Mills.

Mr. W. Patterson, of Walker Gate, Newcastle-on-Tyne, sends us lists of his copper wire gauze dynamo brushes.

Crystal Palace Company's School of Practical Engineering.—The award of certificates for the Easter term took place in the Lecture Theatre of the School on Friday last, April 21st. Sir John Jackson, F.R.S E., presided and addressed the students.

Copper.—From the report of Mason & Barry, now issued, it appears that the total quantity of ore broken and raised at the mine during the year 1898 was 169,775 tons, as compared with 177 549 tons in 1897, and the shipments during the same period (inclusive of ore from the cementation works) was 285,441 tons, as against 267,290 tons in the previous year. The quantity of ore sold and invoiced for its sulphur value during 1898 reached 284,880 tons, against 272,498 tons in 1897. The average price of G.M. copper (including Chili bars) during the past year was £51 16s. 6d., against £49 2s. 6d. in 1897, and £46 18s. in 1896. After writing off £36,823 for depreciation of works, plant, &c., and allowing for the variation in the estimated value of the stocks on hand in this country, on the Continent, and in Portugal on December 31st last, and after deducting management expenses, &c., the net profits on working account have amounted to £37,850, which, with £8,202 received as dividend on La Sabina shares, £6,513 from sundries, and £6,372 brought down, makes a total available profit of £58,938, less £4,500 written off La Sabina shares. A dividend of 5s. per share is recommended, leaving £8,145 to be carried forward. The stocks of ore and copper precipitate broken, raised, and on hand at the date above mentioned were valued at £168,305, and the mine assets in Portugal after writing off for depreciation, £236,753.

The "Cul-de-Sac" Lampholder.—We illustrate below a new lampholder known as the "Cul-de-Sac," which is being introduced by the Edison & Swan Company for high voltage circuits. This holder was patented last year, and it is claimed to be a perfect fitting for high voltage supply. The arrangement of the holder is as follows:—The brass blocks are embedded in the porcelain interior, which is in one piece, and held without screws or attachments of any kind by the simple passing of the plungers through holes in the porcelain. Of patents taken out for improvements in holders within the last 20 years it must be said that their name is "Legion," but it is a fact that the necessity for insuring perfect insulation has always been one of the main objects that inventors have kept in view.



When used on high voltage circuits high insulation is even more necessary. It is claimed for the "Cul-de-Sac" holder that its insulation is absolutely perfect, and there is no possibility of short circuiting between the parts. It has neither screw nor bolt, the brass parts being held in position by the plunger piece passing through a tunnel in the porcelain. The construction of the interior is shown in the illustration, the outer parts being the same as the Ediswan S holder. In putting the brass pieces and the porcelain interior together, the plunger piece is pressed down by the thumb nail, and the brass piece pushed into the tunnel in the porcelain; when pushed "home" the plunger rises through the hole prepared in the porcelain, and the fitting is complete.

Dinner to the Employés of Messrs. Elliott Brothers.—A very interesting gathering took place last Friday evening at the Holborn Restaurant, when about 150 of the staff and employés of the firm of Messrs. Elliott Brothers, 101, St. Martin's Lane, W C., sat down to dinner at the kind invitation of Mr. Elphinstone, who was in the chair, supported by Mr. W. O. Smith and Mr. Willoughby S. Smith. The very excellent dinner having been thoroughly appreciated by the guests, the usual toast of "The Queen and Royal Family" was proposed by the Chairman and met with true English response. The next toast, "The Health of the Chairman," was then proposed by Mr. Arthur C. Heap, who, on rising, said there could be no more fitting opportunity than the present for performing the pleasant duty which had been delegated to him by those assembled, in whose name he had to offer hearty congratulations to Mr. Elphinstone and the lady soon to become his wife, from all associated with him in the firm, and to present to him on their behalf the gold watch and silver punch bowl, as a more substantial token of their goodwill. Mr. Elphinstone, on rising to reply, was greeted with loud cheers and the singing of "For he's a jolly good fellow." When allowed to speak, he expressed in a few heartfelt words his great appreciation of the kind interest felt in his approaching marriage and of the valuable and useful tokens of that interest. He concluded by expressing a hope that they would have many a similar social gathering, and that he and his future wife would often be seen amongst them. Mr. E. B. Stringer then proposed the "Success of the Firm." He referred to the past 100 years, in which the firm had had many successes, and also in a very neat speech, to the double event of the year, *e.g.*, the marriage of Mr. Elphinstone and the moving of the works to the new premises with which the firm had provided themselves at the Century Works, Lewisham, and which was to take place so soon. Mr. W. O. Smith, who replied to the last toast, was listened to with great attention and appreciation by all present. He said it was now some 20 years since the firm had taken it into their heads to build a factory; at the one they now occupied in St. Martin's Lane, the accommodation was too small for their requirements; they had therefore gone further afield and procured land in Lewisham, on which they had erected the New Century Works, now almost complete, and were equipping it with modern plant and conveniences to enable them to maintain the name which the firm had earned in the past. He referred to the anxiety which such a change gave the heads of the firm, and to the keen competition which now existed throughout the trade. He expressed a hope that the employés would be great gainers; firstly, by being able to live close to the works with better light and in fresher air; and secondly, because they would be able to meet in the summer for outdoor sports, and in the winter for social evenings, which at the present time was almost impossible on account of men living so far away. Mr. Smith concluded by giving the toast of "The Employés of the Firm." This was replied to in suitable words by Mr. G. Lawler on behalf of the foremen, and by Mr. Bicknell on behalf of the men. Mr. Spratt then proposed "The Health of Mr. Willoughby Smith," who, in reply, said that though he was not now actively engaged at St. Martin's Lane, he still maintained the interest which he took formerly in their welfare. During the evening a very successful smoking concert was given by members of the staff and the men. The musical arrangements were in the hands of Messrs. Perry and Trollope, and Mr. Longman kindly presided at the pianoforte.

Electric Street Sweeping.—The new cleansing superintendent to the Sheffield Corporation is stated to have invented a method of street sweeping in which the brushes and other parts are worked by electricity.

Electric Wiring Prices.—Electrical engineering firms in the city of Bradford have received the following letter from a local firm of electrical engineers:—

In consequence of the ridiculously low prices in vogue at the present time for wiring, we should be glad if you would let us know in course of post whether you would be agreeable to attend a meeting, at some early date, to discuss the best ways and means of adopting a standard rate of prices for electrical wiring, and the advisability of forming a standard rate of wages for wiremen, as agitated for by the Trades Union.—A. J. Harris & Co.

Electrical Progress in Italy.—The Rome correspondent of the *Financial News* says:—

Electricity is playing a prominent part in the development of our industrial life, and every day we witness the application of it in various forms. Electric lighting is the order of the day throughout the country. Small rural places which never found the means of defraying the cost of a public gas illumination, and were satisfied with oil lamps, have suddenly awakened to the advantages of electric lighting, and have adopted it. Horses and steam power, which used to propel numerous omnibus and tramways, have been replaced by electric traction, and our municipalities are daily petitioned for the granting of similar concessions. Evidently there is no end to the adaptability of electricity, and a patent has just been taken out by Captain Stassano for a process to produce iron and its derivatives by means of special electric furnaces. A group of capitalists and manufacturers of Brescia, Turin, and Rome, confident in the future of the patent, have formed a company for its exploitation, called the Società Elettrosiderurgica Camuna. The capital is 900,000 lire, of which 600,000 lire has been issued in shares of 1,000 lire each.

In re Williamson & Joseph, Limited—Joseph v. the same Company.—On Thursday last week, in the High Court of Justice, Chancery Division, before Mr. Justice North, this, a debenture holder's action, came on for hearing.—Mr. Ingpen, for the plaintiff, asked for the appointment of a receiver and manager.—Mr. T. H. Attwater, for the company, consented.—Mr. Justice North made the appointment.

The Midland Electrical Power Scheme.—The *Statist* says that the above company, which was registered in June of 1897, with a capital of £200,000, is being fostered by a triplet of electrical contractors—Crompton and Co., Limited; Thomas Parker, Limited; and the Callender Cable Company, Limited.

New Business.—Mr. W. P. L. Harrison, has commenced business as an electrical engineer, &c., at Beaumond Cross, Newark, under the style of W. P. L. Harrison & Co.

Personal.—Mr. Douglas L. Wells, M.I.E E., of Brussels, has been elected a Member of the Société Belge d'Electriciens, of Belgium.

Mr. J. A. Kelman has been appointed managing director of the New Zealand Electrical Syndicate, Limited (City of Wellington Electric Lighting), and has resigned the office of secretary, which has been filled by the appointment of Mr. William Lewis.

Removal.—Mr. Arthur Koppel (manufacturer of portable railway material), has removed from 96, Leadenhall Street, to more commodious offices at Peninsular House, Monument Street, E.C.

The Scotch Water-Power Scheme. — A House of Commons Committee on 20th inst. had before it the Highland Water-Power Bill. It is proposed to raise the waters of Loch Ericht 14 feet above their present level by constructing a dam at one end of it. The waters would then be conveyed by tunnels and aqueducts to the head of Loch Leven, and there used for generating electricity. The promoters believe that the provision of a cheap motive power will bring together a manufacturing community on the shores of Loch Leven. The Bill is opposed by the Perth Town Council, Sir J. Stirling Maxwell, Sir J. Ramsden, Sir R. Menzies, and the Tay Salmon Fishing Board. After hearing evidence the Committee adjourned.

South African Electrical News.—The following items of electrical news appear in the last issue of the *British and South African Export Gazette*:—Two dynamos, each of 90 amperes, 550 volts, and a new switchboard, all manufactured by the Electric Construction Company, Limited, have been added to the electric equipment of the Wolhuter gold mine.—An electric light installation for the strong rooms at the Government buildings, Pretoria, has been decided upon.—Extensive additions to the electric light installation of the Legislative Assembly buildings, Pietermaritzburg, are being made.—The question of lighting Port Elizabeth by electricity has again come to the fore by an application from a Mr. Stevenson, representing a syndicate for a concession. The authorities, it may be remarked, at first called for tenders, and finally decided to carry out the work themselves, but have subsequently taken no steps in the matter.—The water and electric lighting scheme of the municipal authorities of Aliwal North, Cape Colony, involving an expenditure of £25,000, has been sanctioned by a public meeting of the ratepayers.

Spon's Architects' and Builders' Price Book.—The new edition for 1899, just published, includes a section on electric lighting giving reliable data as to prices so far as it adheres to the lists of the Edison & Swan Co., but the editorial portion is hardly up-to-date. In the sixth line of the introduction 16-C.P. lamps are spoken of as costing 4s.; in an estimate on 355 they are counted at 3s. 9d.; while a reference to the list on page 359 shows the price to be 1s. 9d. On page 356 the comparison of private lighting with a central station supply shows a considerable saving in favour of the former by supposing the charge for current from a station to be 8d. for lamps burning very long hours.

Theatre Lighting.—Messrs. Mossop & Co., of Queen Victoria Street, have been engaged to fit up the electric light installation of the Holloway Theatre, now in course of erection in Holloway Road, N.

Trade Announcement.—Mr. W. A. Shaw, electrician, &c., has opened premises at 38, Hannah Street, Porth, Rhondda Valley.

"Unbreakable" Pulleys.—We understand that the "Unbreakable" Co's. pulleys are driving the exhibits of the Scottish Laundry Supply Association, of Galashiels, on Stand No. 4 at the British Trades Industrial Exhibition now being held in the Winter Gardens, Southport.

The Weir Feed Pump.—We have received from Messrs. G. and J. Weir a pamphlet relative to their boiler feed pumps. Used largely for many years for marine purposes, in which the pump has amply proved its serviceableness, the makers are now making a land type. They claim that quick running boiler feed pumps are not satisfactory or reliable though they may be cheap in first cost. They are cheap in that only. To be steady and reliable a feed pump must be slow running even though it must be larger and more expensive. The Weir pump is a single direct-acting pump with a valve gear of the positive type, *i.e.*, the pump will start from any position. It has grouped water valves, flange area and small lift for easy working, and small slip, works expansively, and generally is made on the modern system of interchangeability. For stationary purposes the pump is made from 5½ to 9½ inches diameter of water cylinder, and from 15 to 24 inches stroke, the smaller size occupying a floor space 17½ inches × 19 inches, with a height of 76½ inches, the larger size 24 inches × 30 inches floor space, by 9 feet 6 inches high. The speed is considered best at 12 double strokes per minute for boiler feeding, and at that speed the theoretical delivery for the two extreme sizes is 1,793 and 8,521 gallons per hour, off which not more than 5 per cent. need be deducted for slip. The steam valve is double, a main valve to distribute steam to the cylinder and an auxiliary valve to work the main valve, the auxiliary being driven by a lever from the pump piston rod and moving across the main valve in a direction at right angles to the motion of this. The main valve can only come to rest at full travel, so that the pump will always start by turning on the supply valve. Both valves are simple slides, but the main valve is round faced and works in a bored seat. The auxiliary valve works on the flat back of the main valve and admits steam through ports in the valve. This steam finds its way to cylinders into which the ends of the main valve fit as pistons. Thus the main valve is steam actuated, and it can be varied at starting so as to admit steam for full stroke, but otherwise the valve cuts off steam at three-quarters stroke, but how this is effected in a self-moving valve is not in any way stated in the pamphlet.

ELECTRIC LIGHTING NOTES.

Aberdeen.—Four electric arc lamps are to be erected at Queen's Cross in connection with the West End scheme.

Ashton-on-Mersey.—Mr. John Shaw, J.P., electrical engineer, has been unanimously re-elected chairman of the Urban District Council.

Asylum Lighting.—At the annual meeting of the North Wales Asylum Committee of Visitors, the Building Committee have been empowered to obtain tenders for the electric lighting of the asylum. These will be submitted to a meeting of visitors which is to be held to enter into a contract.

Bangor.—The City Council have adopted the recommendations of the Lighting Committee approving of the tenders for proceeding with the electric lighting work. It was remarked in discussion that if there was any further delay the Council would lose some very good customers. Already one had been lost, and the other, it was anticipated, would set up works of their own if nothing definite was done now. The matter has been on the *tapis* now, it is understood, for quite four years. The Council has further resolved to borrow £4,500 to erect a refuse destructor, and another £2,000 for the purchase of electric meters and extra mains as may be required.

The amount of the tenders accepted on Mr. Medhurst's recommendation was £13,052. Mr. Medhurst was last week appointed to prepare plans of dust destructor and subsequently to carry out the work.

Barmouth.—At Barmouth a letter has been received from the Board of Trade by the Urban District Council, stating that in view of the Council's representations, they would decline to proceed with the application for the provisional order for lighting the town with electricity. In the event of the Council applying for an order, they would not be prepared to allow a clause empowering the Council to transfer its powers to a private person.

Barking.—At the last Council meeting it was stated that the electric lighting installation was nearly completed, and that the demand for current had far exceeded expectations.

Bath.—The Council on Tuesday decided to apply to the Local Government Board for a further loan of £8,000 for electric light main extensions.

Beccles.—The Public Lighting Committee having considered Mr. Medhurst's report *re* electric lighting, do not recommend the Council to adopt a scheme at present. The report set out a scheme for public and private lighting at £12,487.

Beckenham.—The Council's officials have been interviewing the Local Government Board with a view to bringing pressure to bear upon them to sanction the electric lighting loan without further delay, so that the work may be put in hand at once.

Bedford.—The electricity works have had several substantial additions to the day as well as the lighting loads lately. The second of the two 24-B.H.P. single-phase alternating current motors laid down to pump the town sewage was started this week. We are informed that they are both giving every satisfaction. Three large new buildings but recently erected—the County Theatre, County Hospital, and Y.M.C.A.—representing an aggregate of 2,500 8-C.P. lamps, are all supplied from the Corporation mains. The applications from new consumers continue to steadily roll in, necessitating a substantial addition to the present plant in the near future.

Belfast.—Mr. McCowen recently submitted to the Electric Committee a map of the proposed extensions. Tenders for steam pipe work, condensing plant, economiser, mechanical stoker, wiring of Council Chamber, and wiring of Free Library were opened, initialled, and referred to the engineer for report. The engineer was instructed to prepare and submit to committee estimates for extending the system.

Bradford.—The electric lighting installation at St. John's Church has just been successfully carried out by Messrs. Rhodes & Webster. The body is amply lighted by seven 5-light and one 3-light electroliers, and over the choir stalls two 5-light electroliers, also there are several other lights and fittings in various portions of the church, chancel, and vestries. All the fittings are of a special church design, green bronzed and copper relieved, and fitted with clear crystal shades. Messrs. Rhodes & Webster also recently carried out a similar installation at St. Jude's Church, Bradford.

Brechin.—It is expected that the Angus Electric Light and Power Company will be supplying current within a year.

Bury St. Edmunds.—Messrs. Crampton & Co., a Cambridge firm of electricians, are opening a branch establishment in Guildhall Street.

Camberwell.—The General Purposes Committee of the Vestry reports that it has had under consideration a letter from the Board of Trade, asking the Vestry's reasons for objecting to the application of the County of London and Brush Provincial Electric Lighting Company for the use of extra high pressure, by raising the permissible voltage from 5,000—5,500 to 6,000—6,600, and stating that the Postmaster-General, the London County Council and the local authorities over all the districts in South London, with the exception of Camberwell, to which the Board's consent to the use of extra high pressure refers, have acquiesced in the amendment asked for. The Committee is of opinion that if the company carries out its legal obligations to provide a generating station in Camberwell for the supply of this parish alone, the voltage of 5,000—5,500 it already

possesses power to provide will be ample for the parish, and the extra 20 per cent. is entirely unnecessary. Further, that having regard to the special purchase clause inserted in the Camberwell order, this objection is not one which concerns either of the other authorities mentioned, but only this Vestry, which therefore strongly urges this objection. The Board of Trade also inquired the Vestry's reasons for objecting to the County of London and Brush Provincial Electric Lighting Company's application for permission to adopt the two-phase alternating current system, instead of the continuous current. The Committee is of opinion that it is desirable to have both systems in force in the parish, and the London Electric Supply Corporation use the alternating current. It was formerly the practice of the Board of Trade to require that when one company supplied by alternating current, the other company should supply continuous current. Hence their opposition.

Chelmsford.—The Chelmsford Electric Lighting Company offered to sell its undertaking to the Council for £40,000, but the Council's electrical expert advises that £24,000 is a fair sum.

Cleckheaton.—A long letter from the Electrical Power Distribution Company, Limited, London, submitting a scheme for putting down a plant in Cleckheaton to supply electricity for power and lighting has been referred to the Gas Committee for consideration.

Coatbridge.—At a recent Council meeting complaints were made of the gas lighting, and one speaker said he thought it was about time they considered electricity for street lighting. The question of purchase of the undertaking of the Scottish House-to-House Electricity Company may shortly come before the Council.

Cults.—A sub-committee of the Aberdeen District Committee of the County Council has been considering offers for the lighting of Cults village by acetylene and electricity. Messrs. P. C. Middleton & Co. are being asked for further details regarding their offer for supplying an electric lighting installation.

Dawlish.—Last week Mr. Taylor (Field & Taylor, electrical engineers), waited upon the Council and gave details respecting the electric lighting of the town, and estimated the cost of a thorough installation of 1,000 lamps at £2,700.

Dock Lighting.—The Mersey Docks and Harbour Board Works Committee has resolved to provide certain electric lights at the new Canada Graving Dock at an estimated cost of £700.

Dublin.—An installation has been put down at the *Freeman's Journal* offices, comprising a Crossley gas engine and a Taunton dynamo for 140 16 C.P. lamps. Mr. H. F. Clayton carried out the work.

Exmouth.—A special meeting of the Council was held last week for the purpose of hearing Mr. Taylor (of Field & Taylor, engineers, London), relative to the lighting of the town by electricity. The consideration of the matter was referred to a committee.

Fulham.—We understand that the Electric Light Committee, after considering the tenders for the various plant, &c., for the electric lighting installation, recommends the acceptance of that of the General Electric Company at a total of £44,968.

Glasgow.—The Electric Lighting Committee have just given a report on the lowest cost at which they will supply current for extensions of the electric lighting of the streets. They state that if the Watching and Lighting Committee resolve upon an extensive scheme of street arc lighting, it may be possible, by grouping several circuits of arc lamps at distributing centres for various districts, to lessen the cost of labour, and, consequently, to still further reduce the price to be charged for each lamp, but the prices following do not apply to the existing single-carbon arc lamps which are now charged at £18 per annum. For double-carbon lamps similar to those recently erected along the Springburn route they propose:—

	£	s.	d.
If the lamps are kept lighted the whole night	14	0	0
If each alternate lamp is extinguished at 11.30 p.m. and left out for the remainder of the night	12	0	0
If each alternate lamp is extinguished at midnight and left out for the remainder of the night	12	5	0
If each alternate lamp is extinguished at 11.30 p.m. and relighted at 5.30 a.m.	13	10	0
If each alternate lamp is extinguished at midnight and re lighted at 5.30 a.m.	13	15	0

At the last meeting of the Corporation, Bailie Maclay, replying to a question, said that the method of charging for electric light would be considered at the end of the current year.

Glossop.—The Board of Trade has consented to reinstate the transfer clause in the Council's provisional order.

Hampstead.—The Vestry will lay mains for the supply of electric current to private consumers down Hermitage Lane to the Castle, Child's Hill, the consent of the Hendon Urban District Council having been obtained. The arc lighting machine required for the completion of the scheme for lighting West End Lane has been ordered of Messrs Siemens at £715. The Lighting Committee has been empowered, as a matter of urgency, to open the tenders which are now being invited for the supply of plant for the proposed extension of the central electric lighting station. This course was said to be rendered necessary because certain plans cannot be drawn until the nature of the machinery is decided upon. If the building is to be erected before next winter no time must be lost in its commencement.

Hawick.—The Board of Trade have made and issued a provisional order for confirmation in Parliament, to the Urban Electric Supply Company, Limited.

Heaton Norris.—The chairman of the District Council last week said that the ratepayers would be glad to know the Board of Trade had at last granted them a provisional order for the electric lighting of the district, and that the Council intended to have the electric light installed as soon as possible. How it was to be done, however, they did not yet know.

Huddersfield.—A Local Government Board inquiry was held on 20th inst. re the Council's proposed loan of £50,000 for electric lighting purposes. Mr. A. B. Mountain (electrical engineer) said the additional generating plant proposed would put them in a position to supply 66,000 8-C.P. lamps, or an increase of 16,000. The plant included in the last application for loan was not yet running. The trouble was that they could not get their plant in time, and they were bound to look ahead. During the past winter the demand for electric current had been so great, that they had actually been running without any spare plant whatever. The present power of the plant was for about 34,000 lamps, and they were working up to 32,000 The last application for a loan was in 1896. The plant under that application, which would bring the power up to 50,000 lamps, should have been ready in October last, but he should say it would be two months before it was ready. He had submitted maps and plans of the proposed extension of mains. He gave details of the estimate as follows:—Seven Lancashire boilers, complete with fittings, mechanical stokers and superheaters, £5,250; one fuel economiser, £700; coal elevating and conveying arrangements, £1,200; two 600-unit steam alternators, complete with exciters, £14,000; steam exhaust, feed water, and condensing pipes, £750; feed pumps and condensing appliances, £1,750; switches and regulating apparatus for generating station, £1,000; transformers, meters, switches, &c., and connecting additional consumers, £8,000; additions to mains, £10,350; mains for supplying Longwood, £5,000; transformers, meters, &c., connecting up consumers in Longwood district, £2,000; total, £50,000. The total length of mains was about 10,000 yards. The loans they had already had sanctioned were £50,000 in 1892 and £50,000 in 1896. The department had no demand for public lighting at present; it was simply private lighting for which the new mains would be laid at present. The chairman of the Electricity Committee stated that the profit on the undertaking during the year ended December 31st, 1898, was £2,437, and the whole of this amount was transferred to depreciation and contingencies fund.

Ilford.—The School Board is asking the Council its charges for current for lighting all the schools by electricity.

Islington.—The Electric Lighting Committee is to report as to the desirability of extending electric lighting to the following roads:—Hornsey Road (to parish boundary), Stroud Green Road, Crouch Hill, Blackstock Road, Gillespie Road, Drayton Park, St. Paul's Road, Newington Green Road (to parish boundary in Newington Green), Mildmay Road, Mildmay Park and Ball's Pond Road, and to bring up estimates of the respective costs to the Vestry.

Italy.—A new water-power generating plant has just been completed and put in operation in the Frigido valley, near Massa. The plant comprises three large Pelton turbines, constructed by Messrs. Riva, Monneret & Co., of Milan, and three alternators by Messrs. Brown, Boveri & Co., of Baden. The current is being distributed to the towns of Massa and Sarzana for lighting purposes, and shortly current will also be supplied to the town of Carrara, not only for lighting purposes but also for the operation of an electric tramway.

Lane End.—The Wycombe (Borough) Electric Light and Power Company, Limited, completed the installation and switched the current on at the village of Lane End last Friday night. The station is owned by Mr. Richard Smith, chair manufacturer, and the steam is supplied from his factory boiler, specially designed to consume the shavings, sawdust, &c., from the factory. The dynamo is by Messrs. Thomas Parker, 220 volts, 75 amperes; the engine is by Robey & Co., and is of 12 nom. H.P., the switchboard being of Edmundsons' type, with accumulator regulating switches, &c. The cables are Callender's three-core, lead covered and steel armoured. There is also a small vertical boiler erected to supply steam when the factory boiler is not in use. There are at present connected to the mains the post office, principal shops, hotel and the largest of the dwelling houses. Mr. Smith expects to connect seven large dwelling houses in the district also. A set of accumulators is to be put down before the winter season. The work has been entirely carried out by the Wycombe Company under the supervision of Mr. E. Salthouse, manager and engineer. The village is five miles from Wycombe.

Limerick.—The extensive new drapery premises opened here by Messrs. Wm. Todd & Co., are fitted throughout for electric lighting. The generating plant comprises two 36-B.H.P. Crossley gas engines, driving two Taunton dynamos, each having an output of 200 amperes at 100 volts, and there is a battery of 55 Tudor cells with a capacity of 643 ampere-hours. There are 80 Jandus lamps in the various departments, and 150 incandescents of 25 and 16 C.P. for the workrooms and domestic rooms, &c. An "Otis" elevator, worked by a 4-H.P. electric motor, communicates with the three upper storeys. The whole of the work was carried out by Messrs. Handley and Shanks.

Leeds.—The Sub-Lighting Committee recommends that North Street, as far as Sheepscar Police-station, should be lighted by means of electricity, and that the electric light should also be extended along Wellington Street to Wellington Road.

Lynn.—At a recent meeting of the Electric Lighting Committee, Prof. Robinson reported the receipt of tenders for meters, viz., Aron Meter Company, £5 10s., Thomson-Houston, £5 6s., Ferranti,

£5 5s., Long-Schattner, £4, the latter being a new prepayment meter, which is likely to prove of much advantage to small consumers, and he advised 50 Ferranti and 20 Long-Schattner meters. He was authorised to obtain them accordingly, also to obtain from Messrs. Spagnoletti and Crookes an estimate for wiring and fittings for the theatre. This course has been approved by the Council. Prof. Robinson has reported as to the progress being made with the buildings and plant. The former are nearing completion, and part of the latter has arrived.

Maidenhead.—To-day (Friday) a ballot is to be taken at Maidenhead on the electric lighting question. The voters are asked to state whether they are in favour of the electric lighting being undertaken by the Corporation or by a private trading company.

The Electric Lighting Committee has recently advised that Messrs. Burstall & Monkhouse be retained as consulting engineers to prepare plans of the scheme for the Local Government Board; also to invite tenders for the necessary works.

Marylebone.—At the last meeting of the Vestry the clerk asked that the seal should be affixed to the Vestry's petition to the House of Lords against the Central Electric Supply Bill. Mr. Brooke-Hitching, in moving that this should be done, stated that the company proposed to obtain powers to lay mains through Marylebone streets without making any return to the Vestry. Mr. Lewis having seconded, Mr. White stated that the material point was as to whether the Vestry would succeed in the House of Lords. The promoters of the scheme were taking advantage of the recommendations made by a joint committee of both Houses, and it was no use for the Vestry to go to Parliament saying that it was outside the area of supply, and to ask the House of Lords to refuse. If they were going to law it would be better to put forward clauses for the protection of the Vestry, as, for instance, a purchase clause, but he thought they would signally fail. Mr. Chick stated that the Electric Lighting Committee were doing what Mr. White suggested. In the first place, they were opposing the preamble. If they failed in that they wanted to determine the route of the mains, and to compel the company to remove them in the event of the roadway being required by the Vestry for other purposes. The resolution to affix the seal was adopted.

Mill Lighting.—The electric light is about to be adopted at Messrs. T. & H. King's large flour mills at Great Chesterford, Essex.

Monmouth.—Last week the electrical engineer reported to the Council that the applications for current were coming in so rapidly that the present turbine plant would be insufficient. The next Council meeting will consider the question of adding a third turbine in order to cope with the demand. It is stated that current will be switched on in a few days.

Newport (Mon.).—At the electricity works the first section of the new electrical machinery is on the ground. The first set of plant is expected to be ready in six weeks. All the steam pipe work in connection with the new machinery is completed.

Nuneaton.—With reference to the offer made by a syndicate to the Nuneaton Electric Company, the company has asked the Council whether the town were desirous of exercising their option of purchase. It was stated that £10,000 would buy the company's business and lay the mains. The Council appointed a committee of five to investigate and obtain the advice of an engineer.

Paignton.—The District Council has considered a proposal by Edmundsons' Electricity Corporation to apply for a provisional order to lay down works to supply electricity, the charge to be 3d. per unit for public lighting, and 8d. for the first hour, and 4d. after for private consumers, the Council to have the option of purchase after 10 years. The communication was favourably received, and referred to a special committee.

Peterborough.—The Town Council have received about 50 tenders for electricity plant in connection with the proposed public lighting scheme.

Richmond (Yorks).—Mr. A. A. Campbell Swinton's report to the Town Council on electric lighting says that the water power available at the old paper mill was variable, but it would be sufficient to light with electricity the 150 lamps now burning gas. Gas is at present sold at 3s. 9d. per 1,000 cubic feet. To make the scheme pay the Corporation should have not less than 3,000 8-C.P. lamps. The installation, plant and mains capable of supplying these would cost altogether about £7,000. Mr. Swinton questions whether such a number of lamps would be taken up in a small town like Richmond. He suggested that the Corporation should leave the matter alone for a few years, as the tendency of electric lighting was to become cheaper. After discussion at the Council meeting, in which the opinion was expressed that it would be best to wait awhile, the matter dropped.

Settle.—The Rural District Council has given consent to the application of the Ingleton Electric Lighting and Power Company to the Board of Trade for a license to supply electricity for lighting and other purposes within the townships of Ingleton and Thornton-in-Lonsdale.

Sheffield.—It is stated that Mr. Alfred Lucas has tendered his resignation of superintendent of mains to the Sheffield Electric Lighting Committee, having accepted a Sheffield and district managership with the British Thomson-Houston Company, who are now equipping the electric trams for this city.

Spain.—La Sociedad Industria Electrica, of Barcelona, has secured a contract for the establishment of a large water-power-driven central station at Colmenar Viego. The plant, which will have a capacity of 2,000 H.P, will comprise four large horizontal turbines, coupled to tri-phase alternators.

Stockport.—The Infirmary Board has decided to light the Infirmary by electricity. A sub-committee has the matter in hand.

West Ham.—Last week a Local Government Board inquiry was held regarding the Council's application to borrow £51,000 for electric lighting purposes. The electrical engineer stated the electric lighting scheme was inaugurated on December 19th, 1898, and the Council were now supplying 12,000 8-C.P. lamps, although they had laid down machinery for supplying 15,000. The engines, exciters, and alternators were estimated to cost £17,000, and three boilers, condensers, and piping, £8,500. The Council had now 80 arc lamps, but they intended to increase them to 160, which would be placed along the High Street, Stratford, and the Woodrange Estate, and in Victoria Dock Road. Mr. Steinitz explained, in regard to the £10,000, that the Council wished to have that sum in reserve for purposes of free wiring when necessary.

Woking.—A meeting of ratepayers was held the other day *re* the electric lighting question, and the following resolution was passed:—"That this meeting of ratepayers of the parish of Woking hereby request the Urban District Council to treat for, with a view to purchase, the electric light undertaking, on the understanding that any profit made, or loss incurred, should fall upon the Station and Maybury ward." Major Cardew was among those who addressed the meeting.

Ystradyfodwg (Maerdy).—Petitions on behalf of the Ferndale Gaslight and Coke and Waterworks Company and owners and ratepayers in Maerdy praying to be heard by counsel against this Electric Lighting Bill when the Committee stage is reached, have been deposited in the Private Bill Office of the House of Commons.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Bath.—Again last week the Council had a discussion on the electric tramway question. The principle of municipalisation was confirmed, but nothing particular was done, as no application can be made until November next. The Mayor thinks that six months' more consideration is desirable.

Blackpool.—It is stated that the fixing of the overhead wire for the new trolley system has proceeded with considerable expedition, and the wire is now completed from the south end to the Foxhall Hotel.

Bradford and Leeds.—An important appeal came before Sir Courtenay Boyle at the Board of Trade last week under peculiar circumstances. The Power and Traction Company proposed to make a light railway, 5½ miles long, between Leeds and Bradford, but both towns objecting to an independent company coming within their boundaries, the Light Railway Commissioners sanctioned only a mile and a half, which would connect the two towns with the proposed extensions of tramways. Both Leeds and Bradford have Bills in Parliament this session to make lines practically to take the place of the light railway, but Bradford has agreed to purchase the order and make the line if it is sanctioned by the Board of Trade. Mr. Pembroke Stevens submitted, on behalf of Leeds, that the proposed line connecting the three miles of tramways of Leeds by a mile and a half loop line joining on to two miles of tramway of Bradford could not be a light railway, but a tramway, which ought to be sanctioned by Parliament under the Tramways Act, and not under the Light Railways Act. Mr. Balfour Browne, Q.C., said that if such schemes as this had to be sanctioned by Parliament, with its consequent expense, then the Light Railways Act would be no use. Sir Courtenay Boyle asked if there was a precedent for a municipality making a tramway out of its own boundary. Mr. Balfour Browne replied that only on Tuesday a Committee of Parliament had sanctioned Glasgow Corporation making seven or eight miles of tramway outside its own boundary. Sir Courtenay Boyle said, according to the *Times*, the questions raised were too important for him to decide on that occasion. They would have to be carefully weighed by the Board, and he would inform the parties when a determination of the points had been arrived at.

Cardiff.—According to Alderman Carey, the Cardiff Corporation will have to spend £260,000 on electric traction, and they will take over the tramways in 1901.

Chester.—The future of the tramways is engaging the attention of the Improvement Committee of the Chester Town Council, and Mr. Thursfield, the electrical engineer, has been instructed to report on the question of electric traction.

Colombo.—At the end of March the Maradana-Borella section of the electric tramways was publicly opened. The Colombo trams are becoming increasingly popular in spite of the opposition offered by the Rickshaw coolies. One of the first cars run on this new section received a handful of stones at its head light.

Dudley.—A Local Government Board inquiry was held at Dudley last Friday into the Council's application to borrow £7,500 for the purposes of electric lighting. The deputy town clerk explained that the Corporation obtained an electric lighting order in the session of 1897, and in March, 1898, resolved to carry out its provisions. The British Electric Traction Company then held the existing tramway from Dudley to Stourbridge, and in 1897 they sought to obtain powers for a light railway within the borough, and also to interfere with the Corporation's rights under the Tramways Act respecting the matter of purchase. This application was opposed by the Corporation, and the result was that an arrangement was made and an agreement entered into between the Corporation and the company. Under this agreement the Corporation retained the right to supply the company with the necessary electrical energy for the tramway and the proposed light railway within the borough. The company had commenced re-laying the main line. The first outlay was mainly for the supply of energy for that portion of the tramway in the borough running to Stourbridge, but the Corporation had under consideration the construction and equipment of a complete scheme of electric lighting in the borough as provided by their order, to which the Board of Trade had given their approval. The Corporation had also retained the right of purchasing that portion of the tramway to Stourbridge within the borough, the length of which was about two miles. Since the posting of the notice of that inquiry the Corporation had decided to borrow an additional £1,000 for the purchase of the land for the electrical generating station. Notice of this had been forwarded to the Local Government Board, and now formed a part of the subject of that inquiry. The land was freehold, and the cost of it was exactly £1,000. Mr. R. Wilson (electrical engineer) gave details of the electrical equipment. Mr Morris stated that the work was well in hand, and the Corporation would be able to supply the electrical energy as soon as the company were ready with the line.

Dudley and Wolverhampton.—Although the British Electric Traction Company have been practically working the Dudley, Sedgley, and Wolverhampton tramway for several months, the actual legal possession of the concern by the company did not take place until Saturday. The company have decided to construct four additional passing places on the line between Dudley and Wolverhampton, to enable them to run a more punctual service. Meanwhile, they will push forward their application for powers to enable them to reconstruct the whole line for electric traction. It is expected that these powers will be obtained in a few months, and directly they are secured the company will commence active operations. The system, when completed, will include light railways from the Sedgley line to Bilston, Willenhall, and Darlaston; from Dudley to Rowley and Kingswinford, and from Stourbridge to Wollaston and Kinver.

The French Orleans Railway.—The *Consular Journal* contains the following curious paragraph:—

> The Orleans (France) Railway Company, that experimented so freely some time ago with electrical locomotives, has just concluded a series of experiments with steam engines lent by the Northern and Eastern Railway Companies. These have been so satisfactory, that they have ceased to coquette with electricity, and the continuance of steam traction has been decided on. They intend very shortly to reduce the Paris-Bordeaux journey by one hour.

Greenock.—The Police Board Special Committee has just considered the report of Mr. Young on the tramway system, also the offer of Mr. Murphy, and the amended proposals of the Greenock and Port Glasgow Tramways Company. After considering these, the committee agreed to recommend to the board that the Greenock and Port Glasgow Tramways Company get notice to quit at the expiry of their lease next year that part of the line from Rue End to Berryburn, and that they be notified at the same time that, in terms of the Act of Parliament, the Police Board will acquire the line from Rue End to Boundary Street. The board have also been recommended by the committee to apply to Parliament, if necessary, for powers to acquire the portions of the system above referred to on behalf of the Corporation, or for authority to lease them. During the discussion it was stated that the offer made by Mr. Murphy was fully £1,000 a year better than that of the Tramways Company, the figures being £3,000 as against £2,000. Mr. Young's report favours municipalisation, but there is said to be considerable feeling in favour of Mr. Murphy's offer.

On Tuesday the board resolved (by 11 votes to 10) to intimate to the Greenock and Port Glasgow Tramways Company that the lease shall cease and determine as on May 15th, 1900, that the Police Board mean to acquire that portion of their tramways situated within the burgh of Greenock; that the Special Committee be appointed to make arrangements with Port Glasgow and Gourock local authorities; and the Greenock and Port Glasgow Tramways Company for the purchase of or for running powers over their part of the respective tramways outside the burgh; that application be made to the Board of Trade for consent to purchase and for working the tramways within and outside the burgh; that meantime the Committee be appointed, if need be, to oppose the Greenock and Port Glasgow Tramways Bill in the House of Commons.

Halifax.—On 20th inst. the Tramways Committee received deputations from the Queensbury and Northowram District Councils urging the extension of the electric tramway system to their respective districts. The Corporation already run cars to Booth Town, and it was suggested that the line should be continued from this place to the Granby Inn, Queensbury, a distance of 2¼ miles. The Northowram Council suggested that the Corporation should continue the intended line to Stump Cross forward to the extremity of the Council's boundary. The additional line would be about one mile in length.

Liverpool.—On 24th inst. the new stretch of electric tramway along Lord Street, from St. George's Church to Paradise Street, was open for traffic. The cars negotiated the sharp curve into Paradise Street with ease and safety.

Llandudno.—The Urban District Council has had correspondence submitted to it bearing on the terms for the supply of the electric current for working the Llandudno and Colwyn Bay light railway. It appears that the Council Committee had submitted terms to the directors, which opened with the quotation of 2½d. per unit up to 250,000 units. The directors, however, urged that these rates were quite impracticable, and expressed a willingness to leave the matter of price to arbitration. If the Council themselves elected to undertake the supply of electric energy, they suggested county rates, opening with a quotation of 1¾d. per unit up to 100,000 units, &c. The committee had adjourned the matter pending further investigation, and the Council endorsed this proceeding.

London County Council and Light Railways.—On the recommendation of the Highways Committee, the London County Council on Tuesday agreed to invite the Middlesex County Council to appoint six members to act in conjunction with six members to be appointed by the London County Council, as a joint committee of the two bodies, to consider and deal with all matters relative to the promotion and carrying into effect of light railway schemes affecting both counties.

The North-West London Railway Bill.—The St. Marylebone Vestry at the last meeting received a letter from the solicitors in reference to the proposed electric railway from Marble Arch to Cricklewood. The solicitors stated that they had submitted to the promoters of the Bill proposals for the insertion of clauses which had been embodied in similar Bills, and so far as they were applicable to the present case; also a clause requiring that the company should not take or use any lands in the parish for the site of the proposed station at Marble Arch. After considerable negotiation and when the Bill came before the committee, the promoters agreed to the insertion of the last clause in the Bill. The station, the letter concluded, would now be situated in Connaught Mews, Paddington.

Ormskirk and Southport.—On 25th inst. Mr. R. H. Scotter, C.E., of Southport, appeared before the Ormskirk Urban District Council to give some details of the scheme which he has originated of an electric light railway between Ormskirk and Southport. A syndicate known as the British and Foreign Light Railway Syndicate was registered on the 18th inst., with a capital of £5,000, to carry out the initial scheme. The distance is about eight miles by road between the two places. At present trams run to Kew Gardens from London Square, Southport, a distance of about two miles, and over these the syndicate propose to seek running powers. From this point the proposed line will follow the road, with the exception that it will pass through Scarisbrick Village to skirt the Count de Casteja's grounds. The motive and lighting power will be electricity, the generating station being at Ormskirk. The passenger cars will have overhead seats, and will be constructed on the American bogey principle, while the light goods waggons are specially adapted for the agricultural needs of the neighbourhood. A feature will be the collection of produce at the farmsteads wherever possible, and its transference to the light railway without reloading. The gauge is adapted to run in harmony with the Lancashire and Yorkshire line, of which the light railway is intended to be the feeder and auxiliary. The Council generally approved of the scheme.

Portsmouth.—The town clerk has received the following:—"The claims of the Portsmouth Street Tramways Company and the Provincial Tramways Company, Limited, made in accordance with Sections 6 and 7 of the above Act, and in pursuance of three notices dated December 31st, 1898, given by the Portsmouth Corporation:—1. For the undertaking authorised by the Landport and Southsea Tramways Act, 1863—£161,764 18s. 1d. 2. For the tramways and undertakings of both companies in the borough of Portsmouth and in the parish of Cosham (including Parliamentary expenses, and omnibuses and carriages, &c.)—£124,914 14s. 5d. 3. For compensation for loss of net profits which might have been obtained by both companies if their undertakings had remained in their possession until the earliest dates next after December 31st, 1899, on which the same could, but for the provisions of Section 7 of the Corporation's Act of 1898, have been purchased by the local authority under the provisions of Section 43 of the Tramways Act, 1870—£19,771 6s. Total, £306,450 18s. 6d. Note—The harness used in connection with the omnibuses and carriages, consumable stores, stable equipment, machinery, plant, tools, furniture, fittings, and sundries, are not included in the above claim. It is suggested that they should be taken over at valuation on the date of the transfer. Dated this 18th day of April, 1899. For the Portsmouth Street Tramways Company and the Provincial Tramways Company, Limited. (Signed) J. Barber Glenn. To the Portsmouth Corporation."

The Potteries Tramways.—It is stated that the overhead electrical equipment of the Potteries Tramways was last week inspected by Major Cardew on behalf of the Board of Trade. A number of trial runs have been made. The inspector expressed himself well satisfied with the system.

Russia.—The horse tramways in the town of Kazan are being converted into electrical lines. The central power station at present in course of erection will comprise three Babcock & Wilcox boilers, three 350-H.P. Corliss engines, and three 250-kilowatt Dulait dynamos. The boilers are to be fired by liquid fuel, brought by steamers on the Caspian to Kazan.

(*Continued on page* 689.)

BOOTLE ELECTRICITY WORKS.

The works of the Bootle Corporation, which were formally opened last week, differ only in detail from the ordinary three-wire system. It is interesting to note, however, that arrangements have been made to supply electricity to such portions of the Liverpool Corporation tramway system which lies within the Borough of Bootle.

Mr. Thos. L. Miller, of Liverpool, is the consulting engineer to the Corporation, the whole of the work having been carried out under his supervision.

The electricity supply works of the Corporation are situated in Pine Grove, on the banks of the Leeds and Liverpool Canal, and adjacent to the Corporation destructor yard. Coal can be obtained direct from the canal, and there is an ample supply of water for condensing purposes.

The buildings have been designed by Mr. J. A. Crowther, the borough surveyor, Bootle, the engine room being 32 feet wide × 42 feet long, the boiler house 50 feet wide × 62 feet long, the battery room 33 feet average width × 56 feet average length, and the pump room 32 feet wide × 32 feet long.

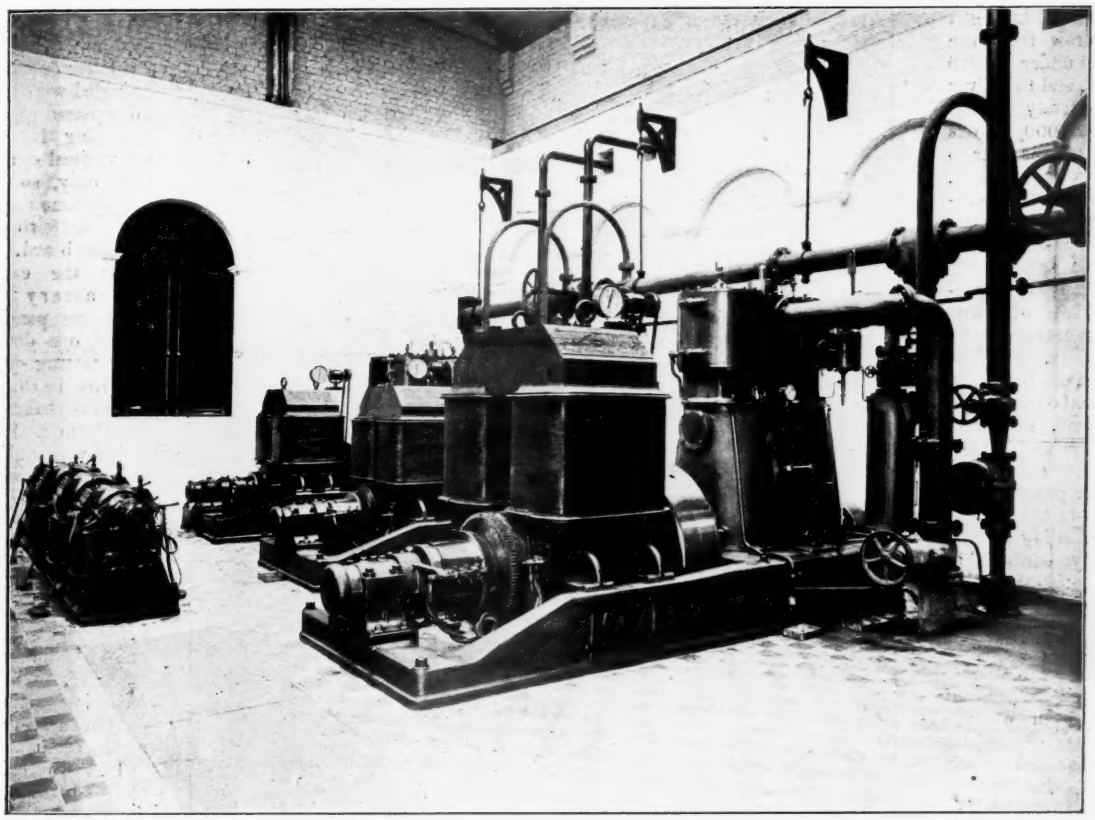
All the buildings are on the one floor, there being no second storey, and the end is temporarily fitted with corrugated iron to allow for extensions being readily made. The whole of the area is covered to a thickness of 2 feet with concrete, and the buildings are of a plain and substantial character, being built of common bricks with red pressed brick dressings. The chimney is 7 feet internal diameter, 150 feet high, and rests on a bed of concrete 30 feet square × 6 feet thick. For a height of 25 feet above ground level the chimney is square, the remaining portion being octagonal.

The supply is on the three-wire direct current system, the pressure at consumers' lamps being 220 volts.

There are three boilers of the Lancashire type by Danks and Co., Oldbury, they are each 7 feet 6 inches diameter × 28 feet long, with two flues each 3 feet diameter at furnace end, tapering to 2 feet 6 inches diameter at back end; each flue being fitted with four conical cross tubes.

The necessary boiler mountings are by Hopkinson, Huddersfield, and there is a Green's economiser consisting of 192 tubes.

There are three compound condensing engines by Belliss,



General View of Interior.

Birmingham, two of them developing 125 I.H.P. when running at 450 revolutions per minute.

The condensers are of the ejector type, by Korting Bros., one being supplied with each engine.

The dynamos are by Thomas Parker, Limited, Wolverhampton, and are three in number, two of 75 kilowatt capacity, and one of 150 kilowatt capacity. They are of two-pole type, and direct coupled to above engines, and are constructed to give any E.M.F. between 440 and 500 volts when running at the specified speeds. They are shunt wound, the regulating switches being placed on the switchboard rail.

There is a balancing transformer, consisting of two balancing armatures directly connected and working in separate fields. This is connected across the outer mains of the three-wire system at the switchboard omnibus bars, and also connected to the centre wire. It is capable of balancing the whole system, so that with a current of 100 amperes in centre

wire, in either direction, the difference of E.M.F. at feeding points between the two sides of the system shall not exceed 4 volts. Directly connected to the balancing transformer, one at either end, are two battery charging transformers, or "boosters," each capable of an output of 130 amperes at 75 volts, and arranged to give any E.M.F. from 10 to 75 volts on open circuit, and capable of running with any current from 0 to 130 amperes at any voltage between that given above.

Two motor-driven centrifugal pumps are placed in pump room, and arranged to draw from the tank under pump room, and to deliver respectively 14,000 and 28,000 gallons of water per hour to the overhead tank, from which the supply to the condensers is taken.

The switchboard is arranged for connection of four dynamos, four feeders, two batteries, one balancing transformer, two boosters, and also for the middle wire connections from feeder points Nos. 2 and 4, the middle wire being permanently earthed at the station through a recording ammeter. The switchboard is arranged on three slate panels carried in steel frames, and cased in on the outside with varnished teak. The instruments and apparatus in connection with the battery, the balancing transformer and the boosters, are arranged on the centre panel, together with the voltmeters and their switches. The instruments and apparatus on the negative side of the dynamos and feeders are arranged on the panel to the right of the centre one, and those on the positive side on the left panel.

In the circuit of each dynamo there is one automatic switch, fitted with fuse, and arranged to drop when the current falls below 10 amperes, and interlocked with this is a shunt switch, by which the field is closed through a non-inductive resistance when circuit is opened, one ammeter, one 25-way multiple contact switch with suitable resistance coils for regulating shunt circuits of dynamos.

In the circuit of each feeder is two duplex fuses, each provided with a switch by which the fuses can be used singly, or the corresponding fuse disconnected, and two ammeters.

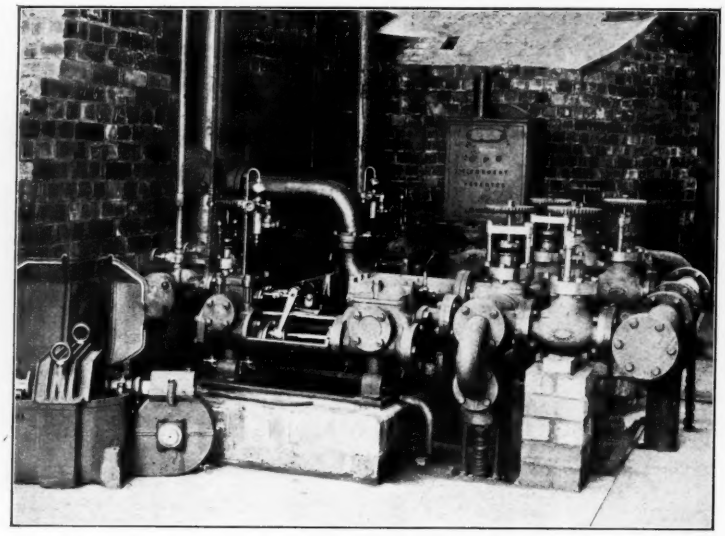
At the back of each outer or feeder panel three horizontal omnibus bars of wrought-copper are fixed, the two upper ones being provided with screw holes placed opposite the plug holes in the vertical feeder and dynamo bars, and the lower one being provided with screw holes placed opposite the plug holes in the vertical dynamo bars only, so that any dynamo may be connected to the traction board.

On the centre, or battery and balancing panel, is placed one double-pole starting switch and fuse in the circuit of the balancing transformer, interlocked with multiple pole starting switch, two multiple way switches for regulating the fields of the transformers, one ammeter in the circuit of each balancing armature, one middle wire ammeter, and one recording ammeter connected up in the earth circuit.

In the circuit of each battery is one single 14-way charge and discharge switch, one battery ammeter, one registering meter, reading direct in ampere-hours, one battery emergency switch, and one single-pole throw-over switch for placing battery either on to the "booster" to be charged or the mains.

In the "booster" circuit, *one* multiple way switch for regulating fields of "booster."

The feed pumps are of the Worthington type, each having a capacity of 1,500 gallons of water per hour against boiler pressure. The feed pipes are arranged to draw from feed tank, and to deliver through



From a photograph by] [*H. Dowden, Bootle.*

Boiler Feed Pumps.

View of Street Arc Lamp.

small heater, and thence through meter to economiser, or else past both heater and economiser to boilers. They are of cast-iron with copper connections to boilers.

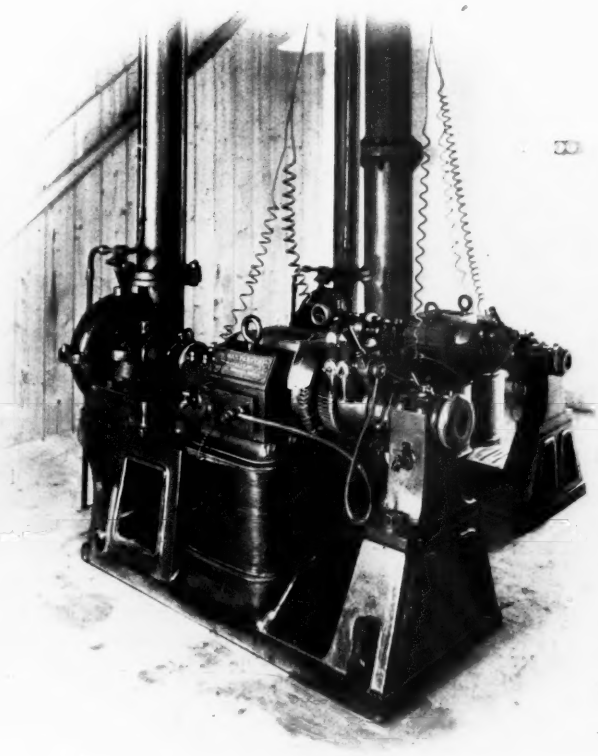
The steam pipes are steel, with branches riveted on the ring main, being 8 inches diameter × ⅜ thick. Branch pipes from boilers are 6 inches diameter, and the bends copper. The main exhaust pipe is 16 inches diameter.

Condensing water pumps draw from brick feed tank, having a capacity of 22,500 gallons, this being placed under pump room, and connected with canal by two inlets, each being provided with a coke filter, and deliver into a cast-iron tank of 7,500 gallons capacity placed on roof of pump house, to give necessary head for condensers. From this tank a 10-inch diameter cast-iron supply pipe is taken, from which branches to the condenser on each engine are led.

A travelling crane by Carrick and Ritchie, and capable of lifting 8 tons, is provided in engine house.

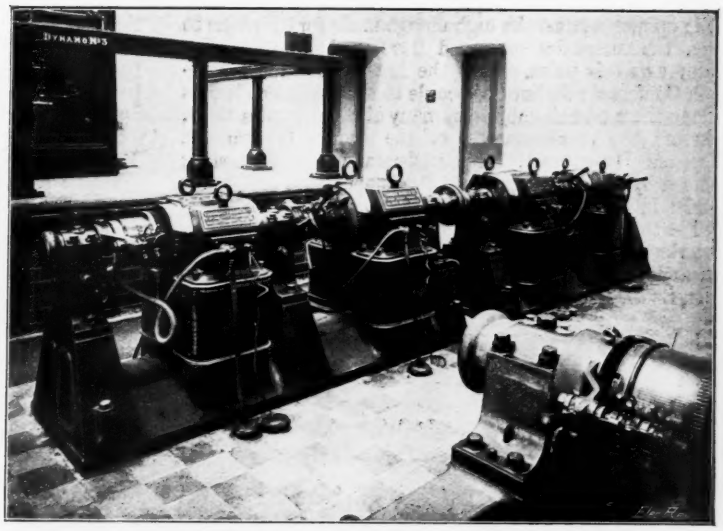
The batteries are of the well-known "R" type manufactured by the Chloride Electrical Storage Syndicate.

These cells are constructed, as most of our readers know, upon a combination of mechanical and chemical principles, embodying the advantages of the Planté and Faure types of plates, and are now in extensive use. There are two batteries, consisting each of 125 cells, capable of maintaining a discharge of 100 amperes continuously for five hours, or 300 amperes for one hour, with a final E.M.F. of 1·86 volts per cell. The cells are contained in glass boxes, which rest on wooden trays supported on glass insulators, and they are suitably arranged on stands for easy inspection. The stands are formed of iron frames, with pitch pine bearers to carry the cells.



Motor Driven Centrifugal Pumps.

The mains are paper insulated, lead covered, and are laid in earthenware troughs, and run in solid with bitumen.



From a photograph by] [*H. Dowden, Bootle.*

Balancing Transformers.

The feeders laid are as follows :—

No. 1	...	...	...	...	·6 square inch.
No. 2	..			...	·6 „ „
No. 3	...	...	...	...	·4 „ „
No. 4	...	...	...	...	6 „ „

Neutral wires being run from the station to Nos. 2 and 3.

Distributing mains are of the following sizes, viz. :—

Large size	·25	·125	·25	sq. in.
Medium size	·15	·10	·15	„ „
Ordinary size	·10	·05	·10	„ „
Small size	·06	·05	·06	„ „

A total of 92 10-ampere lamps have been sanctioned, the lamps being of Johnson & Phillips' make, fixed on poles made by Lucy & Co., each pole being arranged with brackets for two 16-C.P. incandescent lamps, with "Friedreau" lens reflectors, which will be switched in at midnight, when the arcs are turned off. In the extended scheme, for which application is being made to the Council for borrowing powers, the public lighting will consist of 232 10-ampere arc lamps, each fitted with two 16-C.P. incandescent lamps, and 223 converted gas lamps, in which 16-C.P. incandescent lamps in "Friedreau" lens reflectors will be placed.

The Wright system of charging has been adopted, and as the district is almost entirely residential, it will be interesting to watch the development of the system.

The tenders accepted by the Corporation were as under:—

Buildings, Mr. Walter Musker, Bootle	£6,598
Boilers, economiser, steam dynamos, condensers, condensing water pumps, balancing transformers, boosters, feed pumps, piping, and accessories—Messrs. Thos. Parker, Limited, Wolverhampton ...	11,791
Storage batteries—Chloride Electrical Battery Syndicate, Limited	1,049
Mains—British Insulated Wire Co.	10,650
	£30,088

THE EXORBITANT CHARGES FOR TELEGRAMS TO INDIA AND THE FAR EAST.

Notwithstanding the frequent and strong expressions of public opinion against the high charge made for telegrams to India, the companies concerned have made no concession whatever on this point, and at the last International Telegraph Conference declined to accede to the recommendations made to them on this subject by many of the delegates there, including the representatives of the Indian Government Telegraph Department. We understand that a meeting attended by some 20 members of Parliament, who have taken especial interest in Imperial questions, was held on Tuesday last to consider a scheme proposed by the member for Canterbury for cheapening Imperial telegraphic communication and to deal with a motion that the Governments of India, South Africa, Australia, and New Zealand should hold a conference with the Home Government with the object of reducing the present high cable rates, which for social messages are regarded as prohibitive.

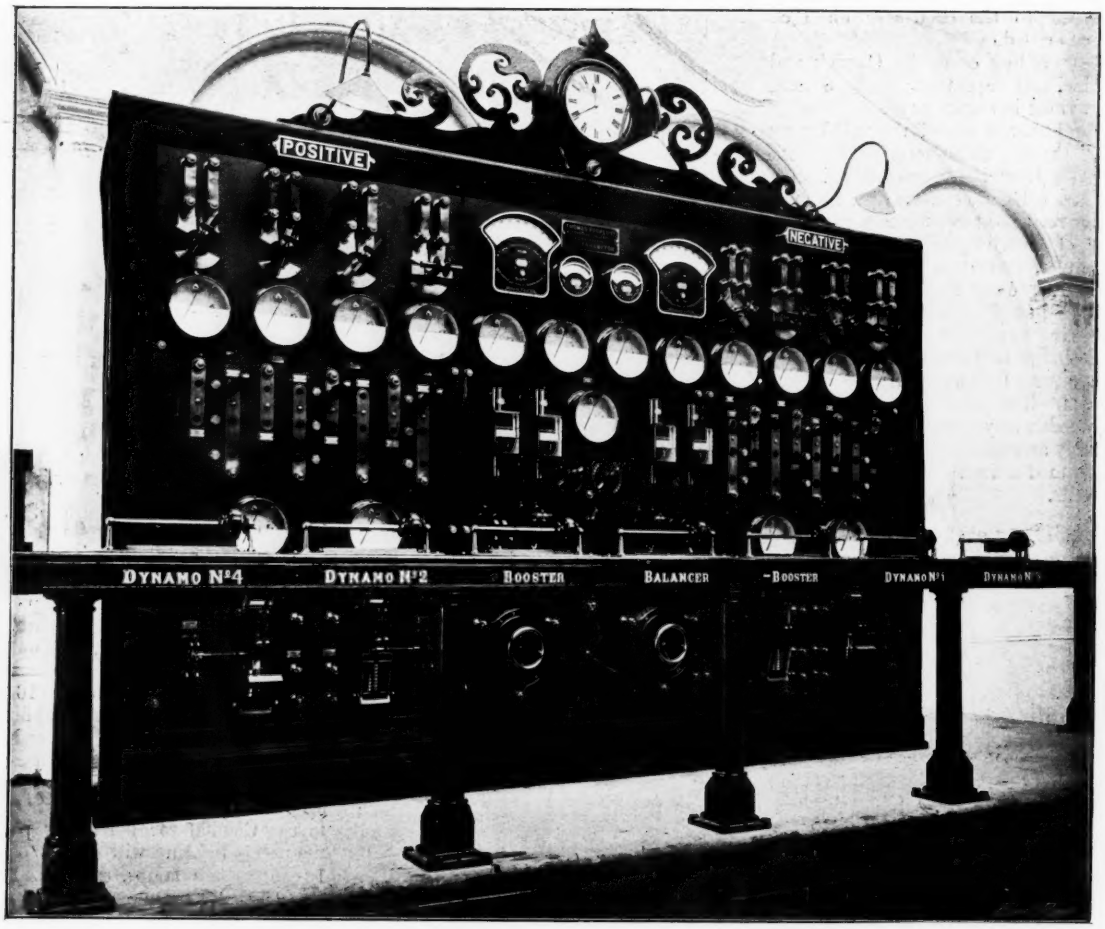
At this meeting Mr. Henniker Heaton, M.P., showed how, by the construction of a short line through Afghanistan, from Merv to the Indian frontier, messages for which 4s. a word is now charged, could be sent to India for about 5½d. per word.

A meeting was held recently of the British Empire League, under the chairmanship of the Earl of Derby, and a resolution calling attention to the excessive charges for cablegrams between the United Kingdom and India was adopted. The *Times of India*, of the 31st ult., gives a full report of the address presented at Bombay to the Viceroy of India by Mr. Allan Arthur, in which the case for a reduction of the high rates charged by the joint-purse companies for telegrams between England and India is very ably set forth. In the course of this address Mr. Arthur states that he has received "telegrams from every chamber of commerce in India pressing the Bengal Chamber to urge the importance of this question on the notice of Your Excellency." Mr. Arthur further pointed out that as far back as 1893 the Government of India declared that "the reduction of the tariff to India is a measure of Imperial importance."

It will be seen from the above that the protest which we have so frequently made in these columns for many years back is justified by the evidence afforded by these and by similar objections made by various important public bodies. The subject was lately brought to the attention of Parliament by Mr. Webster, but no notice was taken, officially or unofficially, of the statement made by him, in view, possibly, of the much greater public urgency of the policing of the West End parks and the extension of Rotten Row, to which subjects the House of Commons mainly devoted its attention that evening.

We have always maintained that the lowering of charges for telegrams to India is well within the power of the companies interested, even apart from the fact that the decrease of rates elsewhere has almost invariably been followed by a corresponding increase in the number of messages sent, which, after the period of transition, during which the natural re-arrangement of traffic takes place, has more than compensated for the reduction made.

A glance at the accounts of the companies interested will prove that their financial condition is such as to warrant their following the example which has met with such successful results in other quarters. Telegrams for India, and for points beyond, such as Australia and China, are carried as far as India by two companies which have a joint-purse agreement, these are the Indo-European Telegraph Company and the Eastern Telegraph Company. The former of these is the proprietor of landlines, which running through various European countries also pass through Turkey and Persia joining



From a Photo by] Bootle Electricity Works.—Switchboard. [*H. Dowden, Boot*

the system of the Indian Government telegraphs at Teheran. The report shows that with a capital of £425,000 this company has paid a dividend of not less than 10 per cent. for the last 13 or 14 years, and besides this has at present a reserve fund of no less than £307,276, which is equal to over 70 per cent. of the capital of the company! This reserve fund, which in the case of a submarine cable company would be looked on as very much more than ample, is ridiculous when applied to a landline system, which is kept in an efficient condition by constant repair and renewal where necessary, and on which a very large outlay has recently been made, the cost of which is paid out of the gross annual revenue. Such a financial state clearly admits of the concessions which the public have so long demanded. As regards the Eastern Telegraph Company, the money invested in the submarine cables used for communication with India is, of course, much greater than that required for the construction of a landline system which does an equal amount of work and as other sources of revenue besides Indian traffic are at the command of this company, it is difficult here to make such a clear statement of affairs as in the case of the Indo-European Company. It may be perhaps sufficient if we refer to an analysis of the proportions in which the money on a telegram to Australia, *viâ* India, is divided out. From a source which we believe to be authentic we draw the following conclusions:—A telegram from London to India, *viâ* either of these joint-purse routes, costs the public 4s. per word, but should this telegram be destined for Australia or the Far East, the 4s. per word is, as far as Eastern Telegraph Company is concerned, carried over their lines for at most 3s. 0½d.; thus the Indian public are placed at a disadvantage, as they have to contribute 25 per cent. more per word towards the carriage of telegrams from India to London than is paid by the telegraphing public in some of the countries lying to the eastward of India. In this respect, at least, it seems that those interested in India may fairly claim a revision and reduction of the existing rate. The capital of the Eastern Telegraph Company, which owns about 28,000 miles of submarine cable, is about £7,250,000, on which they have paid 6½ to 7 per cent. during the last 10 years, and the reserve fund is about £1,300,000, or, say, 18 per cent. on the capital. Comparing this with the financial condition of the Indo-European Company, with its 70 per cent. reserve fund, &c., it is clear that were the joint-purse system non-existent, the competition between these two companies would long ago have resulted in reduced rates to India. Telegrams for China and Japan are to a great extent carried by the Great Northern Telegraph Company, running through Russia and Siberia, which company paid a dividend of 12½ per cent. for the year 1898, carrying forward £61,417. This, however, has not an immediate bearing on the subject we are dealing with, but is only an additional indication showing how profitable telegraph business to the Far East is to the existing companies. With conditions such as those detailed above, it is not astonishing to find that Germany is making preparations to share in such a remunerative business, and that the Emperor himself is much interested in the project. We learn that the Eastern Telegraph Company have made vain attempts in Constantinople to hinder the progress of the German scheme.

In the above, perhaps, may be found the real reason for the recent sudden drop in the shares of the Eastern, and Eastern Extension Telegraph Companies, which the City editor of the *Times* says is generally ascribed to the progress of the Marconi system, although he himself is of opinion that "it is more likely that shareholders are beginning to recognise that these companies are unlikely to escape without loss from the competition by which they are threatened through the construction of a cable to Australia and the Far East across the Pacific Ocean."

Memorial to Clerk Maxwell.—Our readers are again reminded that a subscription has lately been set on foot for the purpose of providing a memorial window, to commemorate the work of Clerk Maxwell, in the parish church of Corsock. Half guinea subscriptions will be gladly received and acknowledged by Rev. George Sturrock, The Manse, Corsock, near Dalbeattie, N.B.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 684.)

Sheffield.—It is stated that the next sections to be taken in hand by the Tramways Committee for electrical traction will be Brightside and Heeley. The precise time for beginning the work will depend on the progress made with the sections now in hand, namely, Ecclesall Road, Intake and Pitsmoor.

South Staffordshire.—The Board of Trade have approved the plans of the Electric Traction Company for the construction of light railways in the Old Hill and Cradley Heath districts.

Swansea Valley.—The British Electric Traction Company intend applying for powers to extend their electric tramways from their Morriston terminus through Woodfield Street and across Morriston to Clydach and Pontardawe, and very probably right through the valley.

Underground Lines for New York.—In a novel, but very enthusiastic way, the New York papers have been championing the cause of underground railways. It seems that the elevated lines are not at all liked by the public, and as additional facilities for traffic have become absolutely necessary, the *Journal* and the *World* have been coming forward with their millions of dollars and inducing the public to subscribe large sums as well, so that underground lines may be proceeded with.

Worcester.—The directors of the Worcester Tramways Company have secured the co-operation of the British Electric Traction Company, with a view to the extension of the tramways in the city, and the adoption of electricity as motive power. The negotiations are being conducted with Mr. E. Garcke, managing director, and Mr. J. A. Lycett, superintendent of the Birmingham district, with a view to ultimate amalgamation. It is contemplated to reconstruct the existing 3 feet lines on a 3 feet 6 inches gauge, and to extend them to Rainbow Hill Cemetery, London Road, and Whittington cherry orchard and Kempsey, Fernhill Heath, Omberaley, Powick and Malvern, and the overhead wire system will be used. The Corporation are at present considering the advisability of taking over the tramway system in the city, and an engineer has been employed to advise whether negotiations should at once be opened with the tramway company, or wait until the expiration of the lease in three years' time.

Yeadon.—The District Council has decided to invite the Councils of Horsforth, Rawdon, and Guiseley, to a joint meeting to formulate a scheme for serving the district with trams.

TELEGRAPH AND TELEPHONE NOTES.

The All-British Cable Scheme.—A Reuter's despatch from Ottawa, dated April 19th, says that Mr. William Mulock, the Dominion Postmaster-General, has given notice of a resolution authorising the Government to enter into an agreement with the United Kingdom and the Australasian possessions to construct, lay, and operate a cable between Canada and Australasia on the following conditions:—A Board of Commissioners to be created under the legislative authority of the British Parliament, and the cable property to be vested in such board in trust for the benefit of the respective Governments sharing in the undertaking, and in proportion to their respective interests therein; the board to issue debentures for the necessary payment of capital, and the said capital, principal, and interest to form a first mortgage on the property and earnings; all the landing points to be in British territory; the number of the Commissioners and their tenure of office to be determined from time to time by the interested Governments, each having appointments of a number proportionate to their contribution; the respective Governments to be interested in the profits and losses in the same proportion. Finally, the Governor in Council is to be authorised on behalf of Canada to guarantee the payment of five-eighteenths of the principal and interest.

Recent telegrams from Ottawa inform us that English despatches cabled to Canada indicate some misapprehension as to the significance of the Pacific cable resolutions of which Mr. Mulock, Postmaster-General, has given notice in the Canadian House of Commons. An examination of these resolutions does not warrant the conclusion that any other Government has decided anything in regard to the Pacific cable question. The resolutions simply give a practical turn to the cable discussions which have extended over ten years, by empowering the Canadian Government to negotiate and contract with any other British Government willing to co-operate towards establishing Pacific cable communication. On this subject the *Canadian Gazette* writes as follows:—

Officialdom can hardly plead that it has no experience of the practical value in pounds, shillings, and pence of the means of immediate and independent cable communication with outposts of the Empire. In the case of the West Indies alone, the Admiralty, if we mistake not, could produce figures which would demonstrate that direct cable facilities permitted economies more than sufficient to cover the amount of the subsidy which secured them. In the Pacific cable project vested interests have again to be taken into account. Monopoly will always fight to the last ditch. But neither the prejudices of officialism nor the exclusive aims of existing corporations should be allowed to

overrule Imperial necessities. The time has fully come for action, and Whitehall's response to Ottawa's pledge of generous co-operation must be speedy and decisive if Imperial responsibilities are to be adequately discharged.

On Monday last Mr. Lowles asked the Secretary for the Colonies whether, in view of the categorical declaration concerning the Pacific cable made by the Canadian Government, and the equally favourable declarations made by the Australasian colonies, he could now state the intentions of the Imperial Government with regard to this project. In reply, Mr. Chamberlain said: No, sir; I am sorry to say I am not yet in a position to make any statement.

Yesterday's *Times* contained the following:—"We understand that a decision has been reached in the matter of the Pacific cable scheme, and that Her Majesty's Government have decided to contribute, in the form of a yearly subsidy, the full amount which they have been recommended under the report of the Pacific Cable Committee of 1896 to guarantee for the construction of an all-British cable running from Vancouver by Fanning Island to Fiji to Norfolk Island, whence it will branch to Queensland and New Zealand."

Cheap Imperial Telegraphy.—In one of the Committee Rooms of the House of Commons on Tuesday night a conference was held, on the invitation of Mr. Henniker Heaton, M.P., between members of Parliament and Colonial representatives on the subject of cheapening the present rates for cabling to British possessions. Sir Edward Sassoon presided. The members present included Mr. Ascroft, Mr. Hogan, Colonel Milward, Sir J. Leng, Mr. Kimber, Mr. William Johnston, Mr. Cochrane, Mr. Arnold-Forster, Sir H. S King, Sir Charles Cameron, Sir A. Scoble, and Sir J. W. Maclure. Among the other gentlemen present were Sir Andrew Clarke (Agent-General for Victoria), Sir David Tennant (Agent-General for Cape Colony), Sir Lepel Griffin, and representatives from Ceylon, the Straits Settlements, and the India Tea Association. Mr. Henniker Heaton said that from London to Vancouver, a distance of 6,000 miles, the charge for telegraphing was 1s. 6d. a word, whereas from London to India, which, by land, was a shorter distance, the charge was 4s. a word. He suggested (says the *Times* report) that the landlines already in existence should be coupled up, so that by a few short stepping-stones across the sea one could telegraph mainly across the land to all our colonies in Africa and Asia, and even to Australia. A landline was constructed at a fifth the cost of a sea cable, and its carrying capacity was much greater. He knew that there was a strong feeling in favour of an all-British system of telegraphic communication; but we allowed our mails to India to be carried through France and Italy, and he did not, therefore, see why we should object to a land telegraph route. The saving would be enormous. For instance, he could send a telegram from London to the Russian frontier of Germany for 2d. a word; that telegram could be re-transmitted through Russia to Merv for 2½d. a word; then there was only a short line needing to be constructed through Afghanistan to enable one to telegraph from Merv to India for 1d. a word, or in all about 5½d., as against the present 4s. a word. Another landline to India might be *viâ* Constantinople to the head of the Persian Gulf, and thence to Karachi. He regretted very much that when Mr. Cecil Rhodes proposed to construct a landline from Cape Town to Cairo, no hand of assistance was held out to him at Cairo by the British Government. A telegram from London to Malta was only 4d. a word, and from London to Tunis only 3d., whereas from London to Cairo it was 1s. 7d. Mr. Cecil Rhodes had suggested to him that there should be a landline through France and Spain to Gibraltar, and then after crossing the Straits, along the north of Africa to Cairo. It was also possible to link up a route to Australia, requiring only about 850 miles of sea cable. Last year £498,477 was paid for cabling between England and Australia, and the cabling to India exceeded £300,000. Altogether £2,400,000 was paid annually for cabling between England and various parts of the British Empire and America; and he believed that, if all the land routes were linked up and utilised, this cost could be reduced by at least 75 per cent. He hoped the Government would appoint a Royal Commission, consisting largely of business men and representatives from India and the colonies, to inquire into the whole system of telegraphic communication between Great Britain and various parts of the Empire, with the object of cheapening and facilitating such communication. A conversation followed, in the course of which it was pointed out by Mr. Arnold-Forster and Sir Fortescue Flannery that, if the land routes became successful, they might kill the sea cables, which, for strategic reasons, would be very undesirable. Sir Lepel Griffin said that, as a naval nation, we must lay the greatest stress on the sea lines. Eventually a resolution, proposed by Mr. Ascroft, and seconded by Mr. William Johnston, was agreed to, forming the members of Parliament and others present (except such as signified their unwillingness to join) into a committee, with a view to steps being taken to facilitate the formation of a cheap Imperial telegraph system. Votes of thanks to Mr. Henniker Heaton and Sir Edward Sassoon were passed.

The Fall in Cable Shares.—On this subject the *Westminster Gazette* writes the following:—

A good deal of dread seems to have taken possession of holders of telegraph shares in connection with the successful experiments in wireless telegraphy. In some cases the fall in prices is really assuming serious proportions. Thus Eastern ordinary stock, which early last week was quoted at about 180, has declined to 160, and Eastern Extension shares have given way from 18½ to 17. In the latter case the fall has occurred notwithstanding the issue of a very satisfactory report showing gross receipts of £290,431, as compared with £275,142 in the corresponding period last year, accompanied by a reduction in working cost from £102,844 to £100,085. It is whispered, however, that the fall in these special securities is not so much due to the somewhat remote prospect of wireless telegraphy affecting their earnings as to the competition which may arise from the construction of a cable to Australia and the Far East across the Pacific Ocean. Nervousness on this score can easily be understood, but there are nevertheless those who declare that Easterns at their present reduced price look very cheap.

The German-American Cable—President M'Kinley is stated to have approved the project of a new cable between Germany and the United States. Its termini may be Emden and New York.

Glasgow Telephone Lines.—At Glasgow, on 19th inst., an inquiry was opened before Sheriff Berry, at the instance of the Lord Advocate, on behalf of the Postmaster-General, in which his Lordship is asked to intervene between the Post Office authorities and the Glasgow Corporation as to laying telephone lines under the city streets. Mr. K. Rigie, advocate for the objectors, said the Postmaster-General urged that he was entitled to the authority whether the Corporation was willing or not, and he was not to agree to the condition that the Corporation would only grant that consent providing it was not to be made applicable to the purposes of any private company. The Corporation's position was that it was not judicious to give a company right to use their streets, because such would deprive them of the control of the streets. This application was a fraud on the Corporation. Refused permission by the municipality, the telephone company incited the Postmaster-General to apply in his own name. Two points came out in the statement of Mr. Fleming, advocate for the Postmaster-General. These were that it was the intention of the Government to give permission as to a wire communicating between Douglas Street and the central exchanges of the telephone company, and that if the present proposal was carried into effect the Postmaster-General would receive rental or a percentage upon traffic in respect of the use of these wires. Mr. Thomas Shaw, Q.C., M.P., contended that there was the same veto against operations by the Postmaster-General as was provided by the Act of 1892 against private companies. Mr. Henry Johnstone, Q.C., said what his Lordship had to determine was whether this municipality or any other was entitled to dictate to the Postmaster-General what use he would make of pipes laid down under the streets under his statutory powers. The telephone was part of the telegraph system, and the Postmaster-General had power to grant licenses and apply for wayleaves from municipalities. Sheriff Berry announced that he would give his judgment in a few days.

Islington Telephones.—The Vestry at the meeting on Friday considered a report from the Works Committee in reference to the proposal of the National Telephone Company to establish a large exchange for 4,000 subscribers in Islington, provided that the Vestry would give the necessary facilities for laying underground wires. The company had asked for an interview on the subject, but as the proposal depended upon the Vestry conceding the right to place the conductors underground, the Works Committee stated that they failed to see that any object would be served by the proposed interview. The Vestry approved the action of the Committee in informing the company to that effect.

The Persian Gulf.—The *Times of India* referring to the report that Russia has secured interest in a port in the Persian Gulf, says that it is unlikely that Russia will make a move at present, but it urges the British people to realise that the Persian Gulf is the real centre of political danger in Asia, and advocates an increase in the number of British political officers in the Gulf and the laying of cables connecting Muscat, Bandar Abbas and Linjah.

Telegraph Rates to the West Indies.—The rates for telegrams to places in the northern division of Cuba have been reduced to 2s. per word, and for places in the southern division of that island to 2s. 11d. Telegrams for Santiago and other parts will be charged at the rate of 3s. 1d., and those to Porto Rico at 4s. 2d. per word. These rates will be chargeable by whichever of the five existing routes the telegram may be sent.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—Cable beyond Gurupa ...	June 11th, 1898 ...	...
French Company's cables—Cayenne-Pinheiro ...	March 10th, 1899 ...	...
Opening of new office at Higuerote, Venezuela	April 21st, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Landlines.		
Communication between Mossamedes and all Inland Offices.	March 16th, 1899 ...	...
Communication between Salonique and Monastir.	March 23rd, 1899 ...	...
Siberian landlines between—Irkoutsk-Werkhne Oudinsk	April 17th, 1899 ...	April 19th, 1899
Saigon-Bangkok ...	April 17th, 1899 ...	April 19th, 1899

Wireless Telegraphy.—A special demonstration of wireless telegraphy was given by Signor Marconi at the South Foreland, on 20th inst., in the presence of the Naval Attaché to the Chinese Legation in London, who is to report to the Chinese Government on the working of the system with a view to its adoption in the Chinese Navy.

CONTRACTS OPEN AND CLOSED.

OPEN.

Battersea.—June 7th. The Vestry wants tenders for the supply of mains, water-tube boilers, steam dynamos and engines. See "Official Notices" April 14th.

Derby.—May 8th. The Corporation is just inviting tenders for the works in the superstructure in connection with the extensions to the electric lighting station, Sowter Road, Derby. Mr. Arthur Eaton, architect, 6, St. James's Street, Derby.

Ealing.—May 15th. Last week we stated in error that the Ealing Council had placed an order with Messrs. Babcock and Wilcox for two 800-H.P. boilers, &c. This should have referred to Halifax, for which town the plant has been ordered. As a matter of fact, Ealing is now inviting tenders for two boilers with superheaters and accessories, as may be ascertained on reference to our "Official Notices" for last week, and to-day.

Ealing.—May 15th. The Council is inviting tenders for steam, exhaust and other piping, &c., switchboard and connections, &c. See "Official Notices" this week.

Edinburgh.—May 15th. The Corporation wants tenders for the supply of copper strip for electric conductors. See our "Official Notices" this week.

Epsom.—May 8th. The District Council wants tenders for various plant for its electricity undertaking, including boilers, dynamos, boosters, batteries, switchboard, crane, mains and road-work, arc and incandescent lamps, and for the lighting of the station. See our "Official Notices" April 7th.

Fleetwood.—May 16th. The District Council wants tenders for lamps and lamp-posts for street arc and incandescent lighting, and also for wiring, switchboards, lamps, &c., for the Town Hall, Free Library, Market, and Slaughter House lighting. See "Official Notices" this week.

France.—May 4th. Tenders are being invited by the French Post and Telegraph Authorities in Paris for the supply of 666 metres run of paper-insulated electric cable. Particulars may be obtained from Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris, to whom tenders are also to be sent.

France.—May 9th. Tenders are being invited by the French Post and Telegraph Authorities in Paris for the supply of 20 kilometres of iron pipes 65 mm. diameter, for pneumatic pipe lines, in four lots. Tenders to be sent to Le Sous Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Hampstead.—May 18th. For the purpose of extensions at the electricity works, the Vestry wants tenders for two 500-kw. steam alternators, five switchboard panels, boilers, feed water heaters, Weir's feed pumps, a 50-kw. exciter, water softening plant, air pump and condenser, Green's economiser and overhead crane. See "Official Notices" April 7th.

King's Lynn.—May 15th. The Corporation wants tenders for electric wiring and fittings for the Municipal Technical School. See our "Official Notices" this week.

London, W.—May 8th. The St. Marylebone Guardians want tenders for electric light wiring and fittings for the new front blocks of their workhouse, Northumberland Street, W. Bills of quantities and a form of tender, &c., upon application to Mr. A. Saxon Snell, F.R.I.B.A., architect, 22, Southampton Buildings, Chancery Lane, W.C., and depositing with him a £10 Bank of England note, returnable as usual.

London.—May 11th. The Great Eastern Railway Company wants tenders for stores and materials. For details of the various items (including telegraph materials). See "Official Notices" this week.

Reigate.—May 1st. The Town Council wants tenders for water-tube boilers, pipe work, two 100-kw. and one 30-kw. steam alternators, overhead crane, sub-station equipment, switchboard, mains, lamp-posts, &c. See our "Official Notices" April 7th.

Southampton. — May 5th. The Corporation invites tenders for the electric lighting, wiring, and fittings for the Municipal Lodging House, Southampton. Detailed specifications obtained from Mr. W. B. G. Bennett, borough engineer, Municipal Offices, Southampton, on payment of £1 1s., returnable as usual.

St. Pancras.—May 16th. The Vestry wants tenders for additional engines, dynamos, &c., at the Regent's Park Station. See "Official Notices" April 21st.

CLOSED.

Aberdeen.—The Gas and Electric Lighting Committee recently accepted a tender of the Westinghouse Electric Company to supply an engine and dynamo at £3,256, and one of Messrs. Babcock & Wilcox for two boilers at £2,086.

Bangor.—The following is a list of the tenders that have just been accepted by the City Council in connection with the electric lighting scheme:—Boilers, R. Hornsby & Sons, £1,490 15s.; steam pipes, &c., Mirrlees, Watson, Yaryan & Co., £1,157; steam dynamos, &c., John Fowler & Co., £2,143; switchboard, &c., Dobson and Curtis Bros., £563 11s. 7d.; accumulators, the Chloride Electrical Storage Syndicate, £920; mains and branches, the British Insulated Wire Company, £3,858; buildings, James Hamilton & Son, £2,920; total, £13,052 6s. 7d.

Brighton.—The Council has given an order to the Tudor Accumulator Company for a battery of 400 amperes capacity, costing £727. The company will purchase the lead of the old battery, which they estimate will bring in £250 to £300.

Chester.—The Council has given a contract to Messrs. Lucy & Co. for the supply of 28 Jandus arc lamp-posts for the sum of £8 8s. each. Mains are to be laid for incandescent lighting in Queen's Park (£300) and in Dee Hills Park at £31.

Doncaster.—The Council sitting in committee has accepted the following tenders in connection with the electric lighting scheme:—For pumps, Messrs. Tetlow Brothers; for engines and dynamos, Messrs. Mather & Platt; for storage batteries, the Electric Power Storage Company; for electric instruments, Messrs. Edison and Swan; for wires and cables, Messrs. Callender's Cable Company.

Glasgow.—Messrs. Henry Pooley & Son have secured a contract from the Corporation for the supply and erection of a 20-ton railway weighbridge for the Corporation's new electric generating station on the south side of the city.

London.—The Metropolitan Asylums Board has accepted the tender of Mr. J. Appleby, of Cornwall Road, S.E., for boiler and engine house and chimney shaft for electric light installation at the Northern Hospital at £2,620.

FORTHCOMING EVENTS.

Saturday, April 29th.—Institution of Electrical Engineers. Students' visit to the Central London Railway. Particulars will be given on post cards.

Monday, May 1st.—At 8 p.m. Röntgen Society, at 11, Chandos Street, Cavendish Square, W. A lantern slide demonstration will be given by Lynn Thomas, Esq., F.R.C.S. (of Cardiff), on "Fractures of the Forearm." Slides and photographs will also be shown illustrating the work of a sectorless Wimshurst machine, by W. Cotton, M.D. (of Bristol).

At 5 p.m.—Annual meeting of the Royal Institution.

Tuesday, May 2nd.—At 3 o'clock. Royal Institution. Prof. Silvanus P. Thompson on "Electric Eddy-Currents." (The Tyndall Lectures—Lecture I.)

Wednesday, May 3rd.—At 7.30 p.m. The Institution of Electrical Engineers. Students' meeting. Paper on "The Enclosed Arc," by L. R. Morshead, student.

At 8 p.m.—Society of Arts. "Ætheric Telegraphy," by W. H. Preece, C.B., F.R.S.

Thursday, May 4th.—At 8 p.m. The Institution of Electrical Engineers at the Society of Arts, John Street, Adelphi. "Electric Locomotives in Practice and Tractive Resistance in Tunnels, with Notes on Electric Locomotive Design," by P. V. McMahon, member.

Saturday, May 6th.—The Institution of Electrical Engineers. Students' visit to be paid to Messrs. Siemens Bros. and Co. Train leaves Charing Cross for Charlton at 9.20 a.m.

NOTES.

Municipal Electrical Association.—A special general meeting of the Municipal Electrical Association was held at the Westminster Palace Hotel on Tuesday afternoon, when representatives were present from Coventry, Derby, Stockport, Newington, Worcester, Paisley, Burnley, Bolton, Huddersfield, Shoreditch, Hampstead, Sunderland, Wolverhampton, Blackpool, Southend, Hull, Bradford, Willesden, Bristol, Liverpool, Islington, Brighton, &c. The Association had under consideration the provisions of the Electric Lighting (Clauses) Act, 1899, and decided to take steps to oppose the Bill, as they considered that some of the clauses were inimical to the interests of the industry. The Association also considered the interim report of the Dangerous Trades Committee, as affecting electricity generating works, which, after discussion, they remitted to the Council of the Association for a report.

Electrodes for Secondary Batteries.—A method of producing electrodes for secondary batteries on what appears to be a somewhat novel principle has recently been devised in Liège, by which the plates are cylindrical in form instead of flat. The flat plate, says *Industries and Iron*, is produced by rolling or casting in the usual way with the ordinary ribs for the peroxide or "active material." The plate, therefore, as completed, presents a fluted surface, which is filled with the peroxide in the customary way. Then the plate thus formed is bent into the shape of a hollow cylinder with the ribs or grooves directed inwardly and parallel to the axis of the cylinder. The longitudinal edges of the bent plate are soldered together and provided with a metal strip for the terminal. It will be seen from this description that the action of bending the plate into a cylinder must have the effect of closing the grooves to some extent at their edges, thereby enclosing the "active material" in a very simple manner.

The Nernst Lamp.—Very little of any interest has been heard about the Nernst lamp since its arrival in this country was announced with a blare of trumpets in February last. It is of the greatest importance for enabling the public to form an opinion of the value of this invention that Mr. Swinburne's figures, which indicated so remarkable an efficiency, should be confirmed or the reverse by independent tests. A letter to a contemporary by Mr. T. J. Johnston, of New York, gives some information on this point. He says that to his knowledge "three experts, not perhaps of such eminence as Mr. Swinburne, but certainly capable electricians and accurate observers, worked on this lamp for many weeks, and finally abandoned it as absolutely impracticable for commercial purposes." As a contribution to the history of the subject, Mr. Johnston mentions that Van Gestel and Beck made experiments in the use of refractory electrolytes heated by an arc in 1885, and embodied their results in U.S.A. patents, Nos. 322,024 and 322,033. This is evidently a development of the experiments of Le Roux (Electrical Review, Vol. 44, p. 279). Quite recently a patent has been filed in the United States by W. S. Hadaway for an invention on the same lines. The arc is closely surrounded by a magnesia sleeve. The light of the arc is augmented by the incandescence of the magnesia sleeve. Crystal of magnesia obtained by fusing magnesia in the electric furnace are ground and mixed in a plastic mass with magnesium chloride. The mixture is moulded under heavy pressure, and is sufficiently strong to be supported wholly by the carbons without enclosing case.

Blondel's Coherer.—M. Blondel, who considers that the Marconi coherer is decidedly better than other forms that have been used, has made experiments with the view of determining the cause of this superiority, and as a result has himself devised a coherer which he considers is in some respects superior to the Marconi instrument. He found that the metal particles must be such as to form on their surface a thin layer of oxide. The thickness of this layer of oxide is of the greatest importance; the coherer will not work well if it is too thick, nor if it is too thin. Marconi has attained success by using mixtures of metals (nickel, silver, and mercury); but Blondel finds that a better result may be arrived at by using alloys. The alloy must contain an oxidisable metal and a non-oxidisable metal, the proportions of these being adjusted so as to give the required degree of oxidisation. Alloys of silver with nickel or copper (for instance, the American or Swiss nickel coins) give the best results. Blondel adds to the glass tube of Marconi a side tube or pocket in which a reserve quantity of filings is kept, so that when the layer of filings between the silver electrodes is fatigued by prolonged use it may be shaken out into the pocket and replaced by fresh filings from the store in the pocket.

Appointments.—Mr. A. P. Hudson, late an assistant electrical engineer in the Post Office service, has been appointed assistant engineer to the Stafford Corporation electricity department.

Mr. J. A. Fraser, formerly with the Brush Electrical Engineering Company, Limited, has been appointed resident electrical engineer to the Oldham, Ashton, and Hyde Electric Tramway, Limited.

Wireless Telegraphy.—On 24th inst. experiments were made at the South Foreland in the presence of a French Commission with a view to demonstrating the possibilities of communicating between a moving ship and the land. The receiving and transmitting instruments on board the despatch vessel *Ibis* were in a cabin, the wire to take the current being connected with the instrument room from the top of the mast, about 150 feet high. The messages were transmitted to the *Ibis* from the South Foreland, from Wimereux, and from the East Goodwin lightship, as also from the gunboat to each of these points, and in each instance they were recorded with unerring distinctness, the French commissioners expressing the greatest satisfaction with the system. Hitherto one of the chief objections raised to wireless telegraphy has been that it is impossible to concentrate the current—in other words, to "cut out" and prevent the message from being received at other stations where installations exist within an equal radius other than the one for which it was originally intended. Signor Marconi has now discovered an ingenious but simple arrangement by which this difficulty can be overcome, and it was on 24th inst. tested before the French Commission and at South Foreland. Messages were first sent from the *Ibis* to the South Foreland, and, as Prof. Fleming pointed out on his recent visit, were received simultaneously by the Goodwin lightship. Signor Marconi's new invention was then tried, and the messages sent to the Foreland were concentrated there, and received at no other point, the lightship being cut out. A similar experiment was made with the lightship, the ships communicating with each other, while the Foreland was cut out. As a further test of this important invention messages were sent simultaneously from Boulogne and the lightship to the South Foreland, where only the Boulogne message was taken by the receiver, the other being cut out at will. This experiment was also tried on board the *Ibis* and from the other points, in each instance with complete success. It is stated that negotiations are proceeding with a view to placing Newhaven and Dieppe in communication by means of Marconi's system of wireless telegraphy. The expense of the installation is likely to be defrayed by the London, Brighton, and South Coast Railway Company on the English side, and the North-Western Railway Company on the French side.

Marriage.—Elphinstone-Wake.—On 25th inst., at St. Cuthbert's Church, South Kensington, George Keith Elphinstone, son of the Hon. E. Buller Elphinstone, to Katherine Amy, daughter of Colonel A. J. Wake, late R.A. After the ceremony a reception, which was largely attended, was held at No. 1, Cromwell Road, S.W.

Chemical Theory of the Lead Accumulator.—The simplest theory of the changes occurring in the lead accumulator is expressed by the equation $PbO + Pb + 2HSO = 2PbSO + 2HO$. On charging, the reaction occurs from left to right, on discharging, from right to left. This process would be a fully reversible one, but many of the changes which occur in the accumulator when at work are not apparently in keeping with this simple view of its action; this is more especially the case with the behaviour on charging and discharging, as the E.M.F. is found to be slightly higher during the first than during the second operation, thus causing a considerable loss of energy. The author traces this loss to the changes which take place in the concentration of the acid, and consequent diffusion and convection, and also production of concentration currents in the cell. Taking these changes into account, the above theory of a fully reversible reaction in the sense given is fully satisfactory. The above is an abstract of a paper by E. Dolezalek in the *Ann. Phys. Chem.*, 1898 (II.), 65, 894—920.

Royal Institution.—On Tuesday, May 2nd, Prof. S. A. Thompson, F.R.S., will deliver the first of a course of two lectures at the Royal Institution on "Electric Eddy Currents." These are the Tyndall Lectures.

Electric Launch for the German Emperor.—It is stated that the Emperor William has ordered an electric motor boat from the Imperial Dockyard at Kiel, to be ready for the regatta there this year.

Institution of Civil Engineers.—The Council of the Institution has made the following awards for papers read and discussed before the Institution during the last session: George Stephenson medal and premium to Mr. R. A. Hadfield; Telford medal and premium to Mr. J. T. Milton; Watt medals and premiums to Sir Albert J. Durston, K.C.B., and Mr. H. J. Oram; Crampton prize to Mr. Francis Fox; Manby premium to Sir William Roberts-Austen, K.C.B.; Telford premiums to Messrs. J. M. Dobson, W. G. Kirkaldy, and A. P. Head. The presentation of these awards, together with those for papers which have not been subject to discussion, and will be announced later, will take place at the inaugural meeting of next session.

The Royal Society.—Among the papers down for reading yesterday afternoon were the following:—Mr. A. A. C. Swinton, "The Luminosity of the Rare Earths when Heated *in vacuo* by means of Cathode Rays." Mr. H. A. Wilson, "On the Electrical Conductivity of Flames containing Salt Vapours." Prof. J. C. Bose, "On a Self-recovering Coherer and the Study of the Cohering Action of Different Metals."

Obituary.—The death is announced of Dr. Carte, J.P., chairman of the Dublin United Tramways Company, and a director of the Cork Electric Tramways and Lighting Company.

The Charge against a Consulting Engineer.—With reference to the report of the prosecution of Henry Cleaver, which appears on page 703 of this issue, we hear that the prisoner was yesterday again before the Cheshire Court, and was remanded for another week to enable the police to complete the whole of their evidence against him.

Concert.—To-night Mr. J. Cecil Bull will preside at the Freemasons' Tavern on the occasion of the annual Bohemian concert of the staff of the City of London, the Metropolitan, and the London Electric Lighting Companies.

Railway Signalling.—With reference to the recent accident near Forest, not far from Brussels, the *Belgian Times and News* says:—

> As a result of the recent commission held by the Belgian Minister for Railways, it has been decided to adopt the entire English system in regard to signals—the continual whistling which is so annoying will be almost entirely done away with. The subject of the proposed Metropolitan Railway here was laid before and discussed by the Chamber of Deputies. Nothing definite has so far been decided upon.

Locomotive Boiler Testing.—The common difficulty in all boiler tests is the exact determination of the bulk of fuel in the fire before and after the test. In a locomotive it is, writes Mr. H. H. Maxfield, easy to be wrong sufficiently to make a 10 per cent. difference on an ordinary test run. In place of thus estimating the fuel, he proposes to start with a banked fire containing usually about 500 lbs. of coal; then, with coal supplied in 100-lb. weighed bags, he would make the test run, return to the round house, and clean and bank the fire again. It would be easy to make the bank near to the size of the starting bank, and even if 100 lbs. out in the estimate, the difference on a run would not exceed, say, 2 per cent., and may easily be kept within 1 per cent. by being careful in the banking. This plan is proposed as the result of observations of express locomotives between Jersey City and Philadelphia, when about 3,000 lbs. of coal will be fired on the trip, 1,300 lbs. having also been added to make up the fire after spreading the bank, and another 300 at the terminal station, and, say, 400 to get up the bank after cleaning. A series of tests made on this system, and compared with the more laborious system of drawing the fire and starting *de novo* with weighed coal, have been found to give results so close to the more careful latter method, as to warrant the adoption of the system for all general tests. The careful all-weighed system introduces too much work into the round house for it to be used for any long series of tests, and if the bank system is fairly accurate, as it appears it should be, it should be useful, and might be also employed for stationary boilers.

A German View of Municipal v. Private Ownership of Central Lighting Installations.—The annual meeting of the shareholders in the Berliner Elektricitäts Werke was held in Berlin on January 10th. In view of the recent discussion at the Society of Arts upon municipal enterprise and its shortcomings, the expression of German opinion given below is of interest. Negotiations between the officials of the company and the city authorities for the transfer of the lighting station to the city have been carried on for some time, but no definite understanding has been reached. The difficulty is, of course, connected with the amount to be paid to the company. New regulations have, however, been introduced into the agreement of 1888 between the company and the city authorities, and these came into force on January 1st, 1899. The capital of the company is to be doubled by the issue of £630,000 new shares. The Allgemeine Company is taking one half of this new issue, and is to obtain as a *quid pro quo* orders for machinery valued at £2,500,000. In the course of his address to the shareholders Herr Rathenau stated his reasons for thinking that municipal ownership would be disadvantageous, and that the present system in Berlin was preferable. These were two:—1. That bureaucratic government does not lend itself to meeting the requirements of consumers. 2. That private companies are more ready to adopt the latest improvements in plant and machinery and to seek improvements in output. In reply to the monopoly argument urged by the supporters of municipalisation, Herr Rathenau stated that in his opinion monopoly was impossible in the electric lighting industry, seeing that consumers could always return to gas lighting, or could erect private lighting plants, when prices became too high.

Lecture.—At the Carmarthen Chamber of Commerce Mr. J. C. Howell, electrical engineer, Llanelly, has been lecturing on "Electricity."

Appointments Vacant.—Prof. Andrew Jamieson having resigned the professorship of electrical engineering at the Glasgow and West of Scotland Technical College, applications are now being invited for the vacant chair. The minimum salary is £400 per annum. See our "Official Notices" this week.

The British Electric Traction Company want a contract or estimating engineer to take charge of the contract department. For particulars as to duties, &c., see "Official Notices" this week.

Only a Slip of the Pen.—A correspondent wishes to know what a contemporary means by Joule's experiment for determining the mechanical *efficiency* of heat. The writer in question, evidently in one of those moments of mental aberration peculiar to him, wrote "efficiency" instead of *equivalent*, but why our correspondent should appeal to us we fail to understand. Only a fortnight earlier the same gentleman attributed the Serrin arc lamp to Sellon, and yet he believes himself to be as infallible as the Pope.

NEW COMPANIES REGISTERED.

Electric Timber Seasoning and Preservation Company, Limited (61,428).—This company was registered on April 10th, with a capital of £150,000 in £1 shares (60,000 preference), to adopt agreements with the Founders' Syndicate, Limited, and Walter C. Johnson respectively, and to carry on the business of timber and wood merchants, importers, exporters, preparers, preservers and seasoners, electricians, electrical and mechanical engineers, suppliers of electricity, and manufacturers of electrical apparatus. The first subscribers (each with one share) are:—F. C. Cross, 33, Grosvenor Terrace, Camberwell, S.E., accountant; H. B. Weaver, 11, Stone Buildings, Lincoln's Inn, barrister; Cecil Brooks, 13, Fairholme Road, West Kensington, architect; F. D. Head, 159, Victoria Street, S.W., barrister; Lawrence Weaver, 83, Gloucester Place, Portman Square, W., architect; E. Choat, Grosvenor Villa, Loughborough Road, Brixton, S.W., clerk; Geo. W. Brown, 28, Handforth Road Brixton, draughtsman. The first directors (to number not less than three nor more than ten) are to be nominated by the subscribers; qualification, £500; remuneration, £200 each per annum and £300 for the chairman.

Lancashire Dynamo and Motor Company, Limited (61,447).—This company was registered on April 11th, with a capital of £100,000 in £100 shares, to carry on the business of mechanical, electrical, and hydraulic engineers, machinery manufacturers, tool makers, steel, iron, and brass founders, boiler makers, millwrights, electrical apparatus manufacturers, chemists, builders, &c. The first subscribers (each with one share) are:—Nicholas Kilvert and Henry V. Kilvert, Mark Lane, Withy Grove, Manchester, lard refiners; A. Tongue, 86, King Street, Manchester, chartered accountant; Wm. Cherry, Spring Clough, Worsley, near Manchester, manager; Edward Pilkington, Clifton House, Clifton, near Manchester, colliery proprietor; William W. Pilkington, The Hazels, Prescot, Lancashire, glass manufacturer; Arthur P. Wood, Wynthorpe, Worsley, near Manchester, engineer. The first directors (to number not less than four nor more than seven) are the first four subscribers; qualification, 10 shares; remuneration as fixed by the company, but none is to be paid unless £5 per cent. is paid. Registered office, 24, Corn Exchange Buildings, Fennel Street, Manchester.

Adams-Randall Telephone Patents, Limited (61,457).—This company was registered on April 11th, with a capital of £60,000 in £1 shares (10,000 £6 per cent. cumulative preference), to adopt an agreement with Charles Adams-Randall, and to carry on the business of a telephone, telegraph, and electric light, heat, and power supply company. The first subscribers (each with one share) are:—John G. Hulbert, 217, Earlsfield Road, S.W., clerk; Wm. H. Parker, 79, Fordwych Road, West Hampstead, secretary; E. J. Broadbent, 25, Albion Square, Dalston, N.E., clerk; Wm. Lloyd, 8, Mountgrove Road, Clissold Park, N., clerk; Joseph C. Colledge, St. Stephen's Chambers, Telegraph Street, E.C., colonial broker; John S. Hall, 45, Chatsworth Road, Brondesbury, N.W., secretary; T. G. Holloway, 17, Kemble Road, Waddon, clerk. The first directors (to number not less than three nor more than six) are to be nominated by the subscribers; qualification, £100; remuneration, £50 each per annum. Registered office, 65, New Broad Street, E.C.

Southampton Cold Storage and Latrage Company, Limited (61,494).—This company was registered on April 14th, with a capital of £250,000 in £1 shares (125,000 preference), to enter into an agreement with Arthur S. Baker, Howard C. Cooke, Tom H. Roberts, John M. Brown, and Robert H. Brown, jun., and to carry on at Southampton and elsewhere the business of cold storage warehousemen, ice merchants, cattle slaughterers, electricians, suppliers of electricity, mechanical engineers, electrical apparatus manufacturers, shipowners, cattle importers, &c. The first subscribers (each wish one share) are:—A. S. Baker, 27, Produce Exchange, New York, U.S.A., merchant; H. C. Cooke, 7, Ranleigh Avenue, Barnes, S.W., merchant; J. M. Brown, West Barns, Dunbar, S.S. manager; R. H. Brown, jun., 42, Lancaster Road, West Dulwich, accountant; T. H. Roberts, Donington House, Norfolk Street, W.C., solicitor; L. J. W. Woodford, Caerleon House, Prestwich, Lancashire, accountant; and E. Cousens, 86, Leadenhall Street, E.C., accountant. The first directors (to number not less than three nor more than seven) are to be nominated by the subscribers; qualification, £500; remuneration, £100 each per annum, and an extra £150 for the chairman; Arthur S. Baker and Howard C. Cooke are managing directors, and John M. Brown is the advisory director and manager for America. Registered office, 9 and 11, Fenchurch Avenue, E.C.

Compass Trading Company, Limited (61,499).—This company was registered on April 14th, with a capital of £5,000 in £1 shares, to acquire the business of Edward Mann, of Palace Chambers, 10, Bridge Street, Westminster, and to carry on the business of general engineers, contractors, financial, commission, and general agents, company promoters, and manufacturers of and dealers in telegraphs, telephones, electrical apparatus, &c. The first subscribers (each with 100 shares) are:—Charles A. Rollason, 13, Berners Street, W., engineer; Westley H. Fletcher, 123, Abbey Road, N.W., architect; Alfred W. Paul, 13, Nicoll Road, Harlesden, N.W., gentleman; Edward T. Pimm, 34, High Street, Harlesden, licensed victualler; Emanuel J. Hale, 129, Rucklidge Avenue, Harlesden, gentleman; George R. Rollason, 26, Greenhill Road, Harlesden, engineer; Wm. F. Fearn, 3, Delahay Street, Westminster, solicitor. The first directors (to number not less than three nor more than ten) are Edward Mann, Westley H. Richards, and one to be nominated by the subscribers; qualification, £100; remuneration as the company may decide.

Heaton & Smith, Limited (61,509).—This company was registered on April 14th, with a capital of £25,000 in £10 shares, to acquire and carry on the business of electrical engineers and electrical apparatus manufacturers carried on as "Heaton, Smith & Co." at Sydney Street, Salford, Lancashire, and to adopt an agreement with Harry Nuttall, Frederick W. Heaton, and Harry Smith. The first subscribers (each with one share) are:—Frederick W. Heaton, 2, Pembroke Street, Seedley, Salford, electrical engineer; Harry Smith, Carlton Villa, Victoria Park, Manchester, electrical engineer; John Eades, 6, Fitzwarren Street, Pendleton, carriage builder; Richard Heaton, 19, Raby Street, Moss Side, Manchester, agent; Thomas L. Marsden, 25, Clyde Road, West Didsbury, publisher; Joseph A. Shaw, 203, Chapel Street, Salford, hatter; Robert Watkinson, 2, Bank Street, Salford, brass founder. The first directors (to number not less than three nor more than five) are:—Frederick W. Heaton, Harry Smith, and John Eades; qualification, £1,000; remuneration as fixed by the company.

Anglo-Belgian Welsbach Incandescent Gas Light Company, Limited (61,519).—This company was registered on April 15th, with a capital of £150,000 in 70,000 preference, 75,000 ordinary and 5,000 deferred shares of £1 each, to acquire the undertaking of the "Société Anonyme Belge d'Incandescence (Systeme Auer)," incorporated in Belgium, to adopt an agreement with the Continental Trust, Limited, and to carry on the business of incandescent light and gas fitting manufacturers, suppliers of gas and electricity, electricians, electrical, mechanical, gas and general engineers, &c. The first subscribers (each with one share) are:—J. T. Norman, Avalon, Putney Common, S.W., consulting chemist; A. J. H. Robertson, Moredun, The Park, Highgate, chartered accountant; A. J. Stanton, 2, Listria Park, Stamford Hill, N., cashier; H. Gunter, 13, Elm Grove, Hammersmith, secretary; H. G. Stephenson, 31, Lombard Street, E.C., solicitor; E. Turkington, 11, Dovecote Avenue, Wood Green, N., clerk; C Mackintosh, 4, Wetherby Gardens, South Kensington, solicitor. The first directors (to number not less than three nor more than seven) are to be nominated by the subscribers; qualification, £100; remuneration, £150 each per annum, and £200 for the chairman. Registered office, 17, Old Broad Street, E.C.

Vaughan & Son, Limited (61,526).—This company was registered on April 15th, with a capital of £50,000 in £1 shares, to carry on the business of mechanical and electrical engineers, machinists, tool makers, iron, brass and steel founders, and manufacturers of and dealers in cranes, hoisting apparatus, dynamos, electric motors, electrical apparatus, engines, boilers, generators, &c. The first subscribers (each with one share) are:—Wm. H. Vaughan, engineer; John T. Vaughan, engineer; and Miss Henrietta Vaughan, Lindum Lodge, Fallowfield, near Manchester; Thomas Foster, Burnage Lane, Levenshulme, near Manchester, engineer; John Markham, bank manager, and Mrs. Elizabeth Markham, Lincoln and Lindsey Bank, Lincoln; Mrs. Gilbert T. Sadler, Hazeldene, Erddig Road, Wrexham. The first directors (to number not less than two nor more than five) are Wm. H. Vaughan, John T. Vaughan and Thomas Foster; qualification, £100.

Sloan Electrical Company, Limited (61,528).—This company was registered on April 15th, with a capital of £15,000 in £1 shares, to acquire the business carried on by Lawrence G. Sloan, at 12, Golden Lane, E.C., as agent for C. Conradty, of Nurnberg, and to carry on the business of electricians, electrical and mechanical engineers, electrical apparatus manufacturers, and suppliers of electricity. The first subscribers (each with one share) are:—George Strong, 40, City Road, E.C., fancy box maker, L. G. Sloan, manufacturer's manager; B. Harrison, cashier, and John M. Sim, clerk, of 12, Golden Lane, E.C.; M. Roberts, 5, Dowgate Hill, E.C., secretary: Theo. Hellers, Ph.D., 31, Batoum Gardens, West Kensington Park, W.; James W. Rook, Chelmsford, manufacturer's agent. The first directors (to number not less than two nor more than five) are Lawrence G. Sloan, John A. Roberts, George Strong, and Wilhelm Buchrenbacher; qualification, £250; remuneration as fixed by the company.

CITY NOTES.

The British Electric Works Company, Limited.

This is the title of a company, the prospectus of which has been advertised during the past week. It is formed to purchase for £142,000 (payable as to £40,000 in ordinary shares, £45,000 in cash or ordinary shares, or partly in both, and the balance in cash) the establishment of an electrical manufactory, freehold land, buildings, and plant, plus certain leasehold property and stock (£5,000), valued at £110,888, thus leaving £31,112 as the purchase price of the remaining assets, namely, certain patents, goodwill, &c. As the factory has been but recently completed and equipped, there can be no statement of profit other than those estimated, and there is, therefore, a great deal that is problematical about the prospectus. The objects of the company are, according to it, to manufacture switches, telephones, terminals, and lampholders, and other electrical accessories, also motors and controllers for tramway and other purposes.

In all these departments of the electrical industry there is, as most of our readers know, considerable competition already, and as telephonic instruments are specially mentioned, we may direct attention to the fact that, although there are some English factories devoting special attention to this branch, a great deal of work in this line is done abroad, mostly on the Continent. It is worth inquiring whether the labour conditions there are not more favourable, and whether automatic machinery (used also there) is going to rectify these in favour of the new concern. Terminals are already competed for here pretty keenly, and lampholders ditto. We do not see that there is anything *put forward* to justify the optimistic view of the promoters, but as there are some good business men associated with it, it is quite possible they may succeed in developing a paying business, though investors should bear in mind the risks they are taking where so much is in the nature of an experiment, an experiment made in departments of the trade where keen competition already exists. The capital it is intended shall stand thus—£50,000 preference shares, £85,000 ordinary shares (of which £40,000 to vendors in part payment), and there are £50,000 of first mortgage debentures *already placed* (it would be interesting to learn with whom), a total of £185,000, so that deducting the £142,000 to the vendors, there will remain £43,000 for working capital.

Submarine Cable Trust.

The Marquis of Tweeddale presided on Wednesday, at Winchester House, over the twenty-eighth annual general meeting of shareholders of the above company, and, in moving the adoption of the report, said the revenue for the year was £21,476 as against £22,997, or an increase of £15,041. It would be seen, however, that the balance of dividend received from the Eastern Extension Telegraph Company in respect of the quarter ended December 31st, 1897, £1,015, had been brought into the present revenue account, while the dividend and bonus on the company's shares in respect of the corresponding quarter of 1898, £4,315, payable on the 27th inst., had not been included, but would appear in next year's accounts. The amount of the Eastern Extension Company's dividend credited to the revenue account this year was £2,214 less than was credited to the account last year. It might be well to explain that this December quarter's dividend was at one time received before the closing of their books, but lately it had not been received till after that date, so that they had not been able to include it until actually received. The revenue account had only been credited with three quarterly dividends from the Central and South American Company, as the last dividend was not received till the 18th inst., but against that they received one year's dividend from the Western and Brazilian Company. They knew that the Brazilian Company's shares had undergone alteration in the past year, but the Trust had not been affected by the transaction. So far as they could see, the present securities held by the Trust were likely to remain undisturbed, so that they would be able to meet the coupons and have a surplus available for the redemption of some of the certificates. The drawings would take place next year and be paid in accordance with the terms of the trust deed. When the whole of the certificates could be purchased it was, of course, impossible for them to form an exact opinion. He must say one or two words in respect to wireless telegraphy, which appeared to have affected the minds of shareholders more than, perhaps, it should have done. In their opinion, wireless telegraphy would never become a serious rival to sub-ocean telegraphy, and men like Prof. Marconi, Mr. Preece, Prof. Fleming, and others, knew the difficulties, some almost insurmountable, which would have to be overcome before wireless telegraphy would be of any use for long-distance telegraphy. They believed the system had a field for operation, and it was quite conceivable that instead of its injuring the submarine cable, it might, under certain circumstances, be a benefit to it.

Mr. Pender seconded the motion, and it was agreed to.

Eastern Extension, Australasia and China Telegraph Company, Limited.

The fifty-first half-yearly ordinary general meeting of the above company was held on Wednesday afternoon, at Winchester House, the Marquis of Tweeddale presiding.

In moving the adoption of the report the Chairman said the gross revenue for the half-year under review amounted to £250,431, or an increase of £15,289. The working and other expenses had amounted to £100,085, showing a decrease of £2,759, due to the cost of the maintenance of cables having been less in the past half-year than in the corresponding period of 1897. Their financial year having closed on December 31st, he dare say they would be interested to know what were the gross receipts and expenditure of the whole year. For the whole year the gross receipts amounted to £567,713, or an increase of £1,822, while the expenditure amounted to £202,958 against £202,269. The usual dividends had been distributed during the year, viz., a dividend of 5 per cent. for 1898, and a bonus of 4s. per share, or 2 per cent., making a total distribution of 7 per cent. for the year. The revenue balance of £51,948 had been carried to general reserve fund, which now stood at £825,609, after having been debited with £56,805 to the cost of cable renewals carried out in the half-year under review. These renewals had been made in the Tasmanian-Victorian, Saigon-Hong Hong, and the Banjoewangie-Port Darwin cables, which had given a considerable amount of trouble during the last few years. The drawing of 473 of the company's 5 per cent. Australian subsidy debentures took place on July 1st, and thus reduced the debenture debt, which originally amounted to £640,000, to £33,000, and next year it would be entirely extinguished. They were aware that the company held an important concession granted by Spain in respect of the cables in the Philippines and other Spanish possessions, and they believed the United States were bound to recognise those concessions by international law, and to take over the obligations given by Spain to the company. They had, therefore, made the necessary representations to the Government of the United States, and expected a definite decision shortly. He might mention that their relations with the American authorities in the Philippine Islands were of the most satisfactory character. The development of the insurrection in the Philippines having made it impossible to maintain efficient telegraphic communication, the company were for a short time compelled to close all their stations in the islands of Panay, Negros, and Cebu, and withdraw the staff to Manila. The times were very exciting ones for their staff, but they conducted themselves, as usual, with great courage and with equal prudence, and elicited great praise from those who were on the island. Since the close of the year the Panay-Negros cable had been re-opened for public traffic, and by arrangement with the Government of the United States, the company's Manila-Capiz cable had been extended to Ilo-Ilo direct, thus making the latter communication independent of the unsatisfactory landlines between Capiz and Ilo-Ilo. This had given very great satisfaction to America, both in Ilo-Ilo and Manila. They had seen from newspapers many references to telegraphic communication between the United States and Australia and between Canada and Australia, nothing, however, was held by the Congress before it adjourned last month, and, judging from recent questions in the House of Commons, the British scheme had not advanced beyond the consideration stage. The offer the company submitted was before the various Governments, and no doubt they might look forward to the matter being settled in one way or another in the course of six months. Considerable discussion had also taken place of late in reference to the cable charges, and suggestions more or less impractical had been made from time to time for reducing the tariffs. It should not be forgotten that during the last few years the tariffs over nearly the whole of the company's system had been revised and substantially reduced, and taking distance for distance, their charges compared favourably with those of any other tariffs in the world. When the Australian tariff was reduced from 9s. 4d. to 4s., under a guaranteed agreement with the Australian Governments, such a heavy loss resulted, that the Colonies requested the company to raise the tariff from 4s. to 4s. 9d. per word. Consequently the existing tariff was actually fixed by the Australian Governments themselves, and it was incorrect as well as unfair to the company to accuse it of maintaining an excessive rate to Australia. Besides that, by an elaborate system of coding, merchants could transmit a great number of words at the cost of one, and that made the tariff only a few pence per word. That agreement of 4s. 9d. a word had another year to run, and if the Governments wished it to be reduced the company would be ready to arrange for it either by guarantee or by a renewal of the subsidy, which came to an end that year. He daresay that those present would expect some observations in respect to wireless telegraphy. It was not surprising that investors who had regarded cable securities as amongst the soundest securities in the market should be startled and alarmed to hear that telegraphic messages could be transmitted from one point to another without cables, and that their property would become of comparatively little value. Because messages could be sent without wires between two places not far apart, it was inferred that the same could be accomplished equally well over long distances, and accordingly a few shares were thrown on the market, and caused a serious falling, similar to that which occurred in gas shares when electricity became known. The system of Prof. Marconi was interesting from a scientific point of view, and in practice, he believed, would be of considerable value for shipping and lighthouse purposes. It would be also of use in making short connections, and it was quite possible the cable companies might apply it as feeders from points at short distances from their main lines, or during interruptions, but that it would ever successfully compete with submarine cables was, in the opinion of those most capable of forming an opinion, in the highest degree improbable.

Mr. Bevan seconded the motion, which was carried.

Consolidated Telephone Construction and Manufacturing Company.

Mr. C. L. W. Fitzgerald presided on Thursday afternoon of last week over the adjourned extraordinary general meeting of the above company held at Winchester House for the purpose of receiving the report of the committee appointed at the meeting on August 18th last.

At the commencement of the meeting the Chairman said they had better dispose, first of all, of the question of proxies. He had sent out proxies because the committee sent out proxies, but he was informed that it would be illegal to use them at that meeting.

Mr. Addison, the solicitor of the company, said their articles of association were very clear that proxies must be lodged before the commencement of the meeting. That meeting commenced when it was first held, and they were from that day merely as a continuation of the original meeting, and it was impossible for the proxies to be issued. The opinion of Mr. Buckley, Q.C., one of the greatest experts on company law, had been taken, and he advised them clearly that proxies not sent in before the meeting on August 18th were not available.

The Chairman said all the shareholders had had the report of the committee, and it was for them now to decide what course to pursue.

Mr. W. R. Lawson, on behalf of the committee appointed on August 18th, said that 63,000 proxies were in favour of the committee's report, and 40,000 in favour of the chairman's. They would remember that at the first meeting of the company proposals were made by the directors very suddenly and unexpectedly that the company should be voluntarily wound up. The shareholders were so much taken back that they positively declined to act on the spur of the moment, and they appointed a committee consisting of himself, Mr. Stoop and Mr. Charles Woolley. The committee at once commenced their investigations, and with the assistance of two of the directors obtained a very considerable amount of information about the work of the company during the past few years. At an early stage it was evident to them that if the company was to survive at all the management should be considerably changed. One of the principal defects of management was the absence of any technical skill or supervision over the works. They looked round to see where they could remedy that defect, and eventually they induced Mr. Hubert Jackson to come upon the board. They would see from the committee's report that they had been in negotiation with the chairman in a most friendly spirit, and they did think that they were on the point of settlement with the chairman. They had an interview with the chairman, and on that occasion neither the chairman nor Mr. Baker distinguished themselves by their courtesy or civility. With regard to the chairman personally, it might be pointed out although he retired from the practical management of the company in 1892, yet he had always supported the manager, and on many occasions where there were divisions on the board, he supported the manager on his casting vote, and on that ground they

were bound to hold the chairman responsible for the management of the company. When they asked Mr. Jackson to come in they were bound to offer him the best position they had, which was the chairmanship, and that had resulted in the dead-lock. He thought it was due, however, to the chairman, to say that what measure of success the company had, took place when he was practically responsible for the management. If they adopted the committee's report they would defeat the motion for voluntary liquidation, and they would also pass a vote of no confidence in the board, whose duty it would be then to consider their position. He concluded by moving the adoption of the committee's report, and this was seconded by Mr. H. Stoop.

The Chairman said that his collesgues on the board took the management out of his hands in 1892 by appointing Mr. Menzies as general manager. He denied the statement of the committee that Mr. Menzies was nominated by himself. He had done his best for 15 years to promote the interests of the shareholders, and he had lost many thousands of pounds by the company. He denied that Mr. Baker and himself had desired to put the company into liquidation, and said that if the undertaking had been managed in the lax way suggested by the committee, it would not be in such good order as it was. All that the company wanted, in fact, was orders. Leaving out of consideration the question of directors, the committee's report, he contended, amounted to a recommendation to the shareholders to appoint an electrician and a works' manager and to get a traveller, and the proposals which he had made himself in his circular reply amounted to precisely the same thing. The whole aspect of matters concerning the telephone industry had been changed since their meeting in August by the Post Office proposals.

Mr. A. H. Baker also denied the statement of the committee that the meeting of August 18th last was called by the directors for winding up the company. At that time the competition was so keen on the part of foreigners, who were not trammelled by trade unions, that the company were practically making no money, and the directors, as trustees for the shareholders, brought before the latter, straightforwardly, the question of liquidation, but they had not suggested that that course should be taken. He afterwards asserted that the prime mover for a winding up of the company was Mr. Stoop. He was himself strongly against a liquidation of the company, especially in view of the entire alteration which had occurred in the position of affairs since their last meeting, as mentioned by the chairman.

After considerable discussion the motion was carried by 11 votes to 6.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee (1) to appoint a special settling day in and to grant a quotation to Davis & Timmins, Limited—50,000 ordinary shares of £1 each and 60,000 6 per cent. cumulative preference shares of £1 each; (2) to appoint a special settling day in British Insulated Wire Company, Limited—29,935 vendors' ordinary shares of £5 each, fully paid, and a further issue of 40 ordinary shares of £5 each, fully paid; and (3) to allow the following securities to be quoted in the Official List:—Doulton & Co., Limited—233,334 5 per cent. cumulative preference shares of £1 each, fully paid, Nos. 516,667 to 750,000, and £233,334 first mortgage 4 per cent. irredeemable debenture stock.

The Chatham, Rochester and District Electric Light Company, Limited.—At this company's meeting, held on 18th inst. at Chatham, the chairman, in moving the adoption of the report, referred to the great improvement in the position of the company, having made a profit during the year, also to the additional plant they were getting into position and have on order, for the purpose of meeting the increasing demands of customers, and also for providing an all-day supply. Reference was made to the extensions of mains during the year. The report and accounts were adopted. The retiring directors, Messrs. F. U. Fuller and F. Jasper, were re-elected.

Prospectus.—Messrs. Alexander Turnbull & Co., engineers, &c., of St. Mungo Works, Bishopbriggs, Glasgow, have converted their business into a joint-stock company, and a prospectus has recently been in circulation. The capital of the concern is £50,000, and the present issue consists of 20,000 preference and 27,000 ordinary shares of £1 each. The business has been established for over 20 years, and the new company takes over the very complete works, stock-in-trade, patents, goodwill, &c. The list was to close on Tuesday last.

Crowded Out.—Reports of Cuba Submarine, Oriental Telephone, and Elmore's German and Austro-Hungarian meetings are held over till next week.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending April 22nd, 1899, were £301 4s. 11d.; aggregate to date, £3,647 6s. 7d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending April 21st, 1899, were £2,618 14s. 10d.; corresponding period, 1898, £2,609 13s. 8d.; increase, £9 1s. 2d.

The City and South London Railway Company.—The receipts for the week ending April 23rd, 1899, were £1,025; week ending April 24th, 1898, £998; increase, £27; total receipts for half-year, 1899, £18,326; corresponding period, 1898, £17,769; increase, £557. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending April 22nd, 1899, were £160 0s. 6d.; week ending April 23rd, 1898, £125 18s.; increase, £34 2s. 6d. Total receipts to date, 1899, £2,421 6s. 9d.; corresponding period, 1898, £1,821 2s. 2d.; increase, £600 4s. 7d. Miles of track open week ending April 22nd, 1899, 3; week ending April 23rd, 1898, 3. Car miles run week ending April 22nd, 1899, 4,245; week ending April 23rd, 1898, 3,149. Number of cars, week ending April 22nd, 1899, 11; week ending April 23rd, 1898, 7.

The Dublin United Tramways Company.—The receipts for the week ending Friday, April 21st, 1899, were as follows:—D. U. T. Co., horse cars, £1,885 4s. 8d.; ditto, electric cars, £1,029 13s. 11d.; D. S. D. Co., electric cars, £868 17s.; total, £3,783 15s. 7d.; corresponding week last year—D. U. T. Co., horse cars, £2,603 4s. 10d.; ditto, electric cars, £508 8s. 10d.; D. S. D. Co., electric cars, £560 0s. 3d.; total, £3,671 8s. 11d.; increase, £62 6s. 8d.; aggregate to date, £53,048 2s. 3d.; ditto last year, £50,139 3s. 1d.; increase to date, £2,908 19s. 2d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending April 23rd, 1899, amounted to £1,352; corresponding week last year £1,452; decrease, £100.

The South Staffordshire Tramways Company.—The receipts for week ending April 21st, 1899, were £606 16s. 3d.; aggregate receipts for 16 weeks, £9,810 0s. 5d.; week ending April 22nd, 1898, £566 0s. 7d.; aggregate receipts for 16 weeks, £9,504 6s. 10d.

STOCKS AND SHARES.

Wednesday Evening.

Chief among the features of the week in the Electric Share Market has been the sharp recovery in those telegraph securities which had been so unduly depressed by fears of aerial companies' competition. Writing a week ago, when the fall was being most acutely felt, we strongly urged that the scare was considerably overdone, and that those people who bought Eastern at 163, or Eastern Extension at 16, would probably not regret it. The prices are now 170 and 16¾ respectively, and we still consider both descriptions afford fair prospect for a further rise, having regard to the fact that the wireless system will, in all likelihood, be made to serve as the handmaid of the existing companies, rather than as their enemy. With reference to the new Pacific cable, it was stated in the House of Commons the other day that the Government were not in a position to make a statement upon the matter at present, so the market, being relieved from this incubus for a while, has almost recovered its usual equilibrium. Anglo-American Deferred have picked up ¼ to 13½, as have Direct United States at 11¼. Brazilian Submarine exhibit no quotable change at 15½. Globes remain at 12, and West Indian and Panama are a steady market at 2 to 2¼.

A fair amount of "good" buying of City Electric Lighting is observable, the price keeps close round 18¼. The Stock Exchange—always ready to take this company's part—is anticipating that the Corporation of London will maintain the City Company's monopoly, as against its competitors, with the view of taking over its wires at no very distant date. Metropolitan Electrics have been rather pressed for sale, and the price at 17 is ¼ down on the week. St. James's and Pall Mall (commonly known in the market as "Jimmies") are ¼ down at 17¾, and there is a good deal of curiosity manifested as to how the new capital is to be issued. The company's Bill was read a second time in the House of Lords on Tuesday. Charing Cross are dull at 11¼, but no variation is noticeable in Chelseas at 8 buyers, House-to-House at 9. County of London are the turn easier at 11¼.

A new company has made its appearance this week under the title of the British Electric Works Company, Limited. The vague generalisations about anticipated profits in the prospectus would, we suppose, be sufficient to make any intending investor recognise that he was embarking in a highly speculative concern, and the amount of the purchase money is more than £30,000 above the value of the tangible assets, as set forth in the prospectus valuation. Another novelty in the market has been the revivifying of the shares of the Wireless Telegraph and Signal Company, Limited. Dealing in these shares has always been more or less a matter of negotiation, but a demand has lately sprung up, and the £1 shares are quoted about 7. The original capital of the company when it was formed in July, 1897, was £100,000, but this was doubled about six months ago. The board of directors is a thoroughly practical one, but as the company has never paid any dividends the present price seems quite exalted enough.

In the railway market there is renewed talk of the era when both the District and the Metropolitan Companies shall have come within the compass of the electric traction department. The price of Districts is 39, and the clique which controls the stock is doing nothing at the moment. Metropolitan Consolidated is quoted 125½ to 126½, and is largely of the nature of a sound investment security. Although the return to an investor is not large, we think that the stock is worth attention now in anticipation of better times to come. Waterloo and City are unchanged at 69.

Among manufacturing companies there has been a weakening of Henley's, the price marking a fall of 1 on the week to 24, but there is nothing to account for the drop beyond a little selling in a market already possessed of quite enough stock. Babcock and Wilcox are 39, Willans & Robinson 10½, while Electric Construction are still 2¼. A fall of 10s. has reduced the price of British Electric Traction to 18½, but beyond this there is little worthy of attention in the traction section. Among tramways, Anglo-Argentine are ½ flatter at 4¼, the report still inducing some of the holders to get out of their shares.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, April 19th.	Closing Quotation, April 26th.	Business done during week ended April 26th, 1899. Highest.	Lowest
124,400l	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	87 — 92	87 — 92	...	...
905,560l	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	60 — 63 xd	62 — 65	65	61
3,047,220l	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	109 —111 xd	112½—113½	115	110½
3,047,220l	Do. do. Deferred...	Stock	...	...	18s. %	13 — 13¼	13¼— 13¾	14⅛	13¼
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 16	15½— 15¾	15¾	15 7/16
75,000l	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	110 —114	110 —114	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	185 —195	185 —195	...	...
1,332,523l	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	106	105
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9½— 10½	10¼	10
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9¼— 10¼	9¼— 10¼	...	...
30,000l	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	...	106 —109%	106 —109%	...	...
60,710l	Direct United States Cable	20	3 %	3½ %	...	10¼— 11½	11 — 11½	11½	10¾
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	102 —105	102 —105	102½	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	...	160 —170 xd	167 —172	172	161
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	100 —104 xd	101 —104	102½	101¾
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	99 —102	100 —103	...	...
1,432,268l	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	125 —129	123 —127	123½	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	16 — 17	16½— 17	17¼	16⅜
16,200l	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	101½	101
64,400l	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000l	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	125 —129	123 —127	123½	...
35,100l	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500l	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000l	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	102 —105	102 —105	...	...
200,000l	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	104 —107%	104 —107%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5⅛ %	11½— 12½	11⅝— 12⅛	12¼	11⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6⅝ %	16 — 17	15¾— 16¼	16½	15½
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 31	31 — 32	30¼	...
92,600	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	100 —103	99½	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	57 — 60	57 — 60	59¼	...
100,000l	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	108 —111	108 —111	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	4½— 5	4 — 4½	4⅞	4 11/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	11⅛	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4¾— 5¼	4¾— 5¼	..	...
1,329,471l	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100½	99
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000l	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	137 —142 xd	137 —142	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,733l	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000l	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	106 —109	106 —109	...	...
88,321	West India and Panama Telegraph	10	1 %	⅝%	...	2 — 2¼	2 — 2¼	2⅛	2
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	11 — 11½	10¾— 11¼	11 1/16	10¾
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	9 — 10	9 — 10	9¼	9
80,000l	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	105 —108	105 —108	...	...
158,100l	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	11 — 12	10½— 11½	11½	10⅝
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	5⅞— 6¼	6	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	8¼	8
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	114 —116	114 —116	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	17½— 18½	17½— 18½	18¼	17⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15 — 16	15 — 16	15½	15¼
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	124 —129	124 —129	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	*nil*	11 — 12	11 — 12	11 3/16	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	...	5¼— 5⅜	5¼— 5⅜	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8¼— 9½	8¼— 9½	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3¼— 4	3¼— 3⅜	3⅜	3¼
48,...	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	6¾	6½
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	106 —108	106 —108	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	17 — 18	16½— 17½	17½	16 13/16
22,500	Do. Nos. 62,501 to 85,000, £7 paid ...	10	...	...	...	13 — 14	12½— 13½	13½	13
220,000l	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —120	118 —121	120½	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	16½— 17½	16½— 17½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	17½— 18½	17 — 18	18	17 2/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £3 paid	5	...	...	...	3¼— 3½	3¼— 3½	3⅜	3 5/16
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15 — 16	15 — 16	15½	15

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued*,
ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation April 19th.	Closing Quotation April 26th.	Business done during week ended April 26th, 1899. Highest	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2¾— 3¼	2¾— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	18½— 19	18½— 19	18 11/16	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13¾— 14¼	13¾— 14¼	14⅛	14
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	128¼	126½
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅞— 2⅛	1⅞— 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜	2⅛— 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —103	102 —105	103	102
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	...	12 — 13	12½— 13	13	12½
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	114 —117	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	9¾— 10¼	9¾— 10¼	10	...
178,303	Do. do. do. £8 paid ...	10	...	...	...	7¾— 8¼	7¾— 8¼	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	3¾— 4	3¾— 4	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	4¼— 4⅜	4¼— 4⅜	...	...
630,000*l*	City and South London Railway	Stock	1 3/16%	1⅞%	2⅛%	68 — 70	68 — 70	68½	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4⅜— 5⅛	4⅜— 5⅛	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3¼— 3⅜	3¼— 3⅜	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	98 — 101	98 —101	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	...	2 — 2⅛	2 — 2⅛	2 3/16	2 1/16
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	...	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	96 — 98	96 — 98	97⅜	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2¼	2 — 2¼	2¼	2⅛
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	105½	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	½— ¾	½— ¾	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	½— ¾	½— ¾	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	24 — 26	23½— 24½	24½	23
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18½— 19½	18 — 20	18½	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	112 —115	112 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21½— 22½	21½— 22½	...	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	101 —105	101 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	3½%	3½%	10 3/16— 10 5/16	10 3/16—10 5/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14⅝— 14⅞	14⅝— 14⅞	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	34 — 38	34 — 38	37	34½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	105 —108	105 —108	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¾— 10¼	9¾— 10¼	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5¾— 6¼	5¾— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	109 —112	109 —112	110	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10½.
British Aluminium, Ordinary, 10—11; 7 % Pref., 11—12.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 107—110. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, ⅜—½.
Smithfield Market Electric, 3—4.
*T. Parker, £10 (fully paid), 16.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd. 1899).

MARKET QUOTATIONS, Wednesday, April 26th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	82/-	82/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	87/-	87/-	..
a Ammonia, Muriate (grey) .. per ton	£19	£19	..
a „ „ (white) .. per ton	£26	£26	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26 10	£25 10	£1 inc.
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£30 10	£30 10	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3¾d.	3¾d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 15	£6 15	..
a „ Recovered .. .. per ton	£5 15	£5 15	..
a „ Lump .. .. .. per ton	£5 5	£5 5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	3d.	3d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£65 to £130	£65 to £130	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8d.	¼d. inc.
c „ Tube (brazed) .. .. per lb.	10½d.	10¼d.	¼d. inc.
„ Wire, basis .. .. per lb.	8½d.	8¼d.	¼d. inc.

METALS, &c. (*continued*).	This week.	Last week.	Increase or Decrease.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£80	£80	..
g „ Wire (basis price) .. per lb.	10¼d.	9¼d.	¾d. inc.
g „ Sheet .. .. .. per ton	£80	£80	..
g „ Rod .. .. .. per ton	£80	£80	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/3	4,3½	½d. dec.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	51/2	48/1	3/1 inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£9 12 6	£9 10	2/6 inc.
g Lead, English Ingot .. .. per ton	£14 12 6	£14 12 6	..
g „ „ Sheet .. .. per ton	£15 12 6	£15 15	2/6 dec.
l Mica (uncut slabs 8" long) .. per lb.	6/6	6/6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 5	£8 5	..
p Phosphor Bronze, plain castings per lb.	1/- to 1/4	1/- to 1/4	..
p „ rolled bars & rods per lb.	1/- to 1/4	1/- to 1/4	..
p „ r'l'd strip & sheet per lb.	From 1/2	From 1/2	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10d. to 1/1	10d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£58	..
g Tin, block .. .. per ton	£115	£115	..
g „ foil .. .. per lb.	1/6	1/4	2d. inc.
n „ wire Nos. 1 to 16 .. .. per lb.	1/6	1/6	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £65	£40 to £65	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j „ Flax, 6 or 8 lea... .. per lb.	4d.	4d.	..
j „ Hemp, 8 ply 10 lbs. .. per lb.	3¾d.	3¾d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£34 10	£33 10	£1 inc.
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£31	£31	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
l Messrs. Sanders, Wake & Co.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

TELEPHONES.*

By JOHN GAVEY.

General.

The invention of the speaking telephone, which was the outcome of the labours of Page, Reis, Graham Bell, Edison, Hughes, and numerous successive inventors, has entirely modified the means of rapid and accurate inter-communication, not only within limited areas, but between cities and towns many hundreds of miles apart, and this method of communication, which is proving such a rival to the older form of telegraphy, has aroused such widespread interest that your Council have thought it desirable that a paper on the subject of Telephones and Telephone Exchanges should be laid before you.

After describing the telephone receiver and the telephone transmitter, the lecturer described

The Circuit.

When the telephone was introduced as a practical instrument it was discovered that it formed by far the most delicate detector of alternating or vibratory currents that had been placed in the hands of the scientific investigator or the practical electrician. When joined to a single wire, the circuit of which was completed through the earth, and which was in proximity to other circuits similarly joined up, innumerable noises were heard when the neighbouring wires were worked. Disturbing secondary currents, some due to earth leakage, some to electrostatic, and some to electro-magnetic induction, were generated by the adjacent working currents, so that if these were used for telegraphic purposes buzzing and frizzling sounds were heard on the telephones, of such intensity as to render speech impossible. On the other hand, if the neighbouring circuits were used telephonically, and were in excess of a certain length, the conversation held on one circuit could be heard on all the neighbouring circuits. When, however, two wires were used to form a complete metallic circuit, and when they were so placed in regard to all neighbouring wires that the average distance between any one of the latter and the two former was the same throughout, then the electromotive force due to induction in one of the wires of the circuit was equal to and opposed to that in the other, no disturbing currents circulated, there was no leakage from earth, and a silent circuit was provided, in which nothing interfered with satisfactory speech.

As early as 1881, when the first Post Office telephone exchange was opened, the Department erected metallic circuits, and this policy has been adhered to throughout. Most of the other administrations and companies throughout Europe and America, however, started with single-wire circuits, and this is one of the principal causes of the dissatisfaction which many members of the public have felt with the telephone service. To reduce the overhearing between neighbouring single-wire circuits, it was found necessary to use somewhat imperfect transmitters, which only admitted of good articulation when the users spoke in gentle tones, and even then the circuits were noisy, inefficient, and unsatisfactory. In justice, however, to those who started on these lines, it must be said that in the early days of telephone exchange work there was no form of insulated wire thoroughly adapted for use for underground purposes, and it was practically impossible to erect aerial wires in the enormous numbers that soon became necessary to provide metallic circuits for the large exchanges that rapidly arose. Gutta-percha and India-rubber insulated wires were very costly, they took up much space, and their static capacity was so high that the limit of distinct speech was soon reached.

The invention of paper insulated air space multiple cables has led to a revolution in telegraphic practice. They are relatively cheap, they take little space, a conduit that would hardly hold 80 gutta-percha wires will accommodate 408 wires insulated with paper, and the static capacity of the latter is but one-fourth that of the former, which practically means a fourfold increase in the range of speech when underground circuits are in use. Specimens of these cables are exhibited.

All European and American administrations and companies have availed themselves of this new form of underground cable, and at present about three-fourths of the exchange service in these countries is provided by means of complete metallic loops. Their use is being rapidly extended, so that within a relatively short period the single-wire telephone exchange circuit will be a thing of the past.

It may, however, be well to refer to the fact that for long distance speech, over trunk lines connecting distant places, we are still practically restricted to the use of open wires for the relatively high static capacity, and the considerable electrical resistance of the small conductors used in these paper cables, although not very detrimental on short lines, would render speech over long distances utterly impracticable under present conditions.

The Switch.

The history of the modern switchboard in its elementary form extends back to the early days of telegraphy, for the most serious problem which has confronted telephone engineers, namely, the ready method of placing a large number of subscribers in rapid and simultaneous intercourse with one another, arose in a minor degree when public telegraphs were first inaugurated. It was obviously impossible to erect wires between every two individual towns throughout any country, and in order to avoid re-transmission of messages at intermediate points, *i.e.*, the writing down of a message received at B, from Station A on one wire, and the sending of it to Station C on another wire, a system was devised by means of which all the circuits in a central office were terminated on a series of brass bars fixed horizontally on a suitable base, and a second series of similar bars was fixed at right angles to and insulated from the former. The two lots of bars were pierced with holes and provided with pegs, and it was possible to make direct connection between any two of the horizontal bars on which the telegraph circuits were connected by inserting pegs through these into one and the same vertical bar. An old-type switch is exhibited. This was termed an Umschalter switch, but it gradually fell into disuse, as it was soon found to be more speedy and more economical to transmit the messages by writing them down at one instrument and handing them to another operator to send over the second instrument, rather than to wait till both the circuits were free and ready to be connected through direct.

In the year 1864 the Universal Private Telegraph Company reintroduced the use of these switches for providing connection between subscribers to their private-wire telegraph system so as to place them in direct communication with each other, and what was virtually a telegraph exchange was established by them. The system was subsequently extended by the Post Office to several towns in Great Britain.

On the establishment of the first telephone exchanges in this country the Edison Company started with a switch of the fixed bar and plug type just referred to, whilst the Bell Company introduced a board in which flexible cords, connected to plugs, were used for joining through the circuits. This was the direct progenitor of the modern system of switching.

The operation of telephone switching on small exchanges is a simple one. When the shutter of an indicator drops, the operator inserts one plug of a connecting cord into the corresponding jack, and by depressing a speaking key brings her telephone into the circuit. She ascertains the requirement, inserts the second plug of the cord into the jack of the subscriber who is wanted, depresses a ringing key which actuates the bell of the second subscriber, and the latter, on answering, finds himself in communication with his correspondent. The apparatus is exhibited. The calling up of the exchange has been effected in various ways. In one, the most common, the subscribers are provided with a small magneto-machine, set in motion by a cranked handle. The turning of this handle drops the Exchange indicator. In others, primary batteries have been used.

Again, a system known as the "Law" or "Call wire" system has been tried. In this an independent circuit extends from the Exchange to a certain number of subscribers, each call circuit serving from 40 to 60 persons. It terminates in a telephone at the Exchange, at which an operator is listening continually. To obtain attention a subscriber depresses a special key on his local telephone, which switches it into the call circuit, and if no one is speaking, he makes his wants known. If another subscriber be using the call circuit, the former waits his turn. The operator, on hearing his requirements, makes the necessary connections as before, the subscriber releases the "Call key," and his telephone is thereby cut out of the call circuit and restored to his speaking circuit, on which he listens till he hears his correspondent answer.

Finally, in the Post Office, a system was designed, under the instructions of Mr. Preece, by which the removal of the telephone from its suspending hook actuated the indicator at the exchange, and this method has now been adopted, and, with certain modifications—which will be described later—it promises to become the standard type of working in the United States.

When the conversation is finished, the reverse operations are performed. If the call is originated by ringing, a brief ring is repeated, and this drops a second indicator shutter which is bridged in the connecting cords, and which is an instruction to the operator to disconnect the two circuits. With the "Call" system, instructions to sever the connection are conveyed on the call wire, and finally, with the Post Office system, the restoration of the telephone to the hook sends an automatic signal to the exchange, which indicates the close of the conversation.

Where a special operation is necessary to insure the severance of a connection, much difficulty occasionally arises through a subscriber omitting to ring or call off; under these conditions other subscribers who wish to speak to either of the two who are joined through, are told that he is engaged, and much discontent and trouble have arisen from this cause. The advantage of a system which abolishes this special operation, and substitutes an automatic signal on the hanging up of the telephone, is obvious.

So long as exchanges were of limited size, these simple types of switching readily met all requirements; but as the number of subscribers increased, and the switchboards grew to such dimensions that several operators had to be employed, a difficulty arose in making connections between circuits beyond the reach of a single operator. This was at first met by providing what are termed office junction circuits between each operator and all the others; but as the system became more extensive, the number of these junctions and the difficulty of manipulation increased to such an extent, as to render this method of working impossible.

To meet this difficulty, the multiple board was designed. This board is divided into sections, usually of such a size as to provide space for seating three operators, and on each section appear the local jacks and indicators of a number of subscribers, varying from 200 upwards, according to the average number of calls dealt with daily. In addition, however, to these local jacks and indicators, all the circuits of the whole of the remainder of the subscribers to the exchange are attached to a series of jacks fixed on the upper panels of the section, so that each operator is in a position to connect any one of the local subscribers, for whose calls she is responsible, directly to any other subscriber on the exchange. It is, however, evident that before a subscriber connected to a local section is joined through to any other subscriber, it is necessary to ascertain that the latter is not connected through at another section of the board to a

* Abstract of paper read before the Society of Arts, April 12th, 1899.

third subscriber, and this is ascertained in a very ingenious manner. On the face of each jack is a metallic socket, and resting on this socket is one of the springs of the jack itself. These springs and sockets are so connected that on the insertion of a plug into a subscriber's jack, at any section of the board, the socket spring is moved into contact with a stud that connects a battery with the whole of the sockets of the jacks which serve that particular circuit. If a subscriber who is wanted is engaged, the fact is indicated to any operator in the exchange by a click in her telephone when she touches, with the tip of the plug to which her telephone is for the time being connected, the socket of his jack on her section. If she hears no click, she assumes that the subscriber is disengaged, and connects him through to the calling subscriber.

The early types of multiple boards were extremely costly, and they were subject to many defects which led to the introduction of other systems which were designed to cheapen the service and to improve the working. This again put the advocates of the multiple system on their mettle, with the result that the modern multiple board, as at present manufactured, appears to meet, within its capacity, most of the requirements of a thoroughly efficient telephone system.

I propose to describe briefly the latest form of multiple board, designed by the Western Electric Company, which embodies the most recent developments of American practice.

First, the Post Office system of automatic "calling" by the removal of the telephone from its hook, and automatic "clearing" by the restoration have been adopted; but the progress of modern discovery has placed at the command of telephone experts improved methods of which they have availed themselves. Thus, small electric glow lamps, worked by relays, have been substituted for the necessarily somewhat cumbersome drop indicators previously used in most exchanges. These glow lamps can be placed in any position, vertical or horizontal, and they take up such little space that they can be fixed in the exact localities in which their indications are most readily observed, instead of having to be placed, as in the older boards, at a considerable distance from the jacks and cords with which they are worked. Thus there is no need for hesitation or thought on the part of the operator whilst trying to connect in her mind a distant signal with the particular operation to be performed, for each lamp indicator is in immediate proximity to the jack or plug, as the case may be, which has to be used.

Under each subscriber's local jack at the exchange is placed one of these glow lamps, which is normally dark, but which acts as the subscriber's calling signal. On the keyboard, and close to each of the connecting cords and plugs, are two similar lamps, the use of which is indicated in the following description of the *modus operandi*:—

On the removal of the subscriber's telephone from the hook the calling lamp immediately under his jack at the exchange lights, and the operator, without a moment's hesitation, inserts a disengaged plug into the jack. The insertion of this plug extinguishes the "calling lamp," and the operator presses the speaking key forward and simply says, "number." On receipt of the reply from the calling subscriber the second plug of the pair is used, in the first place, to test the line on the multiple of the subscriber wanted, and then, if the latter be disengaged, for insertion in that subscriber's jack. This action lights the lamp nearest the operator on the keyboard. She reverses the speaking key for a brief interval, and this has the effect of ringing the bell of the subscriber wanted. On his removing the telephone from its hook the front lamp is extinguished, the two subscribers are in correspondence, and the operator is made aware, by the lamps ceasing to glow, of the fact that her work for the time being is complete. Should either subscriber hang up his telephone, as is sometimes done while searching for information, one only of the keyboard lamps lights, but no notice is taken of this, unless it should remain in that position for an undue period. When, however, the conversation is really finished, and both subscribers restore their telephones, both keyboard lamps light, and this is an absolute signal to withdraw the connecting plugs, which action is followed by the extinction of the keyboard lamps. If the subscriber wanted is engaged or fails to answer, the operator says to the originating subscriber, either "busy" or "does not answer," and on the latter restoring his telephone, the lamp on the keyboard furthest from the operator lights, and she withdraws the plug. It will be observed that the speaking in the course of manipulation is reduced to a minimum. When there is nothing to prevent an immediate connection, only one word is uttered by the operator, and this is increased to two when the connection cannot be made. Switches illustrating the series of operations are exhibited in work.

One great advantage of the automatic method of signalling, whether Post Office or Western Electric, is the fact that it maintains the line under a constant test; for should a fault arise on the wires at any time, the signals give warning of the fact by indicating a call to which no answer can be obtained. A lineman is at once despatched to remedy the defect before a subscriber has learnt that anything is wrong.

In the Western Electric system, also, the individual primary batteries at each subscriber's office are replaced by central storage batteries at the exchange, which are used both for speaking and signalling purposes. The process of replacing primary by secondary batteries at all large telegraph offices in this country has been in progress for some years, and these batteries also have been in use on the Department's trunk lines for automatic signalling purposes for a considerable period, but their use for speaking purposes also is a promising innovation.

Of course, various types of modern switchboards exist, most of which have some advantage to recommend their use, but I have thought the description of the above would have particular interest, as being the outcome of the general experience in the United States, which may be termed the home of telephony.

If the capacity of a multiple switch were unlimited, and the telephoning of large cities could be effected by concentrating the whole of the circuits in one exchange, the problem would be easily met by the use of a switch of the above, or of some similar type. Unfortunately, the number of subscribers who can with advantage be served on one switch is limited, the largest now in use providing only for 10,000 subscribers. The limit is due to various causes. The range of an operator's reach is not great, and it is obviously useless to extend the multiple jacks beyond her reach. There is also a limit to reduction which can be effected in the size of jacks, so that it is impossible to crowd more than a certain number within a given space. There are also other objections to which specific reference need not be made, but the result is that to deal with a large number of subscribers it is necessary to establish several exchanges, and these are connected together by junction circuits. These circuits are virtually the equivalent, in a certain degree, of the trunk circuits connecting the larger cities and towns, and they are now almost universally worked by means of automatic signals, but a detailed description of the methods in use would scarcely have sufficient interest to justify further explanation here.

It will be interesting to quote certain figures relative to the Central Exchange belonging to the French Government in Paris.

It is at present fitted up for 15,000 subscribers, and to provide for this number no less than 702,000 jacks are joined up. To connect these within the interior of the building there are 118 miles of 40-wire cable, giving an aggregate of 4,720 miles of wire in the switch room. These cables are cut and jointed to the jacks at intervals of about 12 inches, and this has involved the making of 2,500,000 soldered joints.

I mention these figures because it has become the fashion to underestimate the work of constructing a modern telephone system.

To take an analogy. It is a simple matter to provide the catering for a single establishment, but there are few problems of greater magnitude than the provisioning of an army of, say, 100,000 men. In the same way, any plumber-electrician can run up a few score wires and connect them to a switch, but when the wires grow from scores to thousands, and tens of thousands, spread over an area of some

Approximate Mileage of the Telegraphic and Telephonic Systems of the World, January, 1899.

	Lines.				Wire.			
	Telegraph lines.		Telephone lines of States and private companies.	Totals.	Telegraph lines.		Telephone lines of States and private companies.	Totals.
	State administrations and private companies.	Railway companies.			State administrations and private companies.	Railway companies.		
I.—Countries subject to the International Telegraphic Convention:—	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.	Miles.
European	490,200	179,570	169,300	839,070	1,604,300	623,200	852,800	3,080,300
Extra-European	167,300	64,620	14,290	246,410	406,100	205,300	119,230	730,630
II.—Countries not subject to the Convention:—								
North America—								
Western Union Company	233,000	...	...	233,000	1,003,400	...	...	1,003,400
Postal Telegraph Company	18,640	...	...	18,640	108,730	...	...	108,730
Other offices	...	248,500	186,400	434,900	...	745,600	2,175,000	2,920,600
South America	15,533	9,300	3,107	27,940	29,820	27,960	31,070	88,850
Africa, Asia, and Australia	24,853	27,950	9,320	62,133	74,560	83,850	24,850	183,290
III.—Submarine cable companies...	167,800	...	...	167,800	169,600	...	...	169,600
	1,117,526	529,950	382,417	2,029,893	3,396,510	1,685,940	3,202,950	8,285,400

hundreds of square miles, the problem becomes as intricate as that involved in any other type of heavy electrical engineering.

The telephone trunk service of Great Britain, in other words, the system which provides intercommunication between the principal towns in the country, was fully described in a paper I had the honour of reading before the Institution of Electrical Engineers in November, 1896, and there has been no material modification in the methods then described. On March 31st, 1898, the Post Office plant comprised 56,373 miles of wire at work and in course of construction, and 269 towns were connected with trunk circuits, by means of which any one of them could be placed in direct connection with any of the others. The system is being rapidly extended.

The table on page 700, which shows the mileage of the telegraphic and telephonic systems throughout the world at the end of the year 1898, will be of interest. It is compiled from official documents supplied to the Bureau International de Berne.

Finally, I may venture to say that it is almost impossible to predict the future of the telephone. There is room for unlimited growth, and great as have been the developments of the ordinary methods of telegraphy, they are probably destined to be entirely eclipsed by the telephone which may before long be the principal channel through which both business and social intercourse of the country will be carried on.

The discussion opened by the chairman was continued by Mr. Kingsbury, Mr. Sinclair, and others, when a vote of thanks to the lecturer was carried unanimously.

DIRECT AND ALTERNATE CURRENT DISTRIBUTION.*

By H. H. WILLIAMS, Student.

The subject of direct and alternating currents is one which has received considerable attention from electrical engineers both in this country and abroad.

I think I am right in saying that it has more reference to central station engineers than to any other section of the electrical community.

Again and again has this subject been treated from a central station standpoint, yet in these days of progressive electrical industry, when each week we read of more municipalities and companies applying for provisional orders to enable them to supply a district with electricity for both public and private use, it seems to me that the subject is of the utmost importance to suppliers and consumers alike.

Before deciding upon a system of electrical distribution for a district, the engineer does not (or ought not to) study only the conditions and requirements of that district at the time of commencement of his undertaking. He must very carefully consider what will be the character of the district and the nature of the demand in, say, 10 or even five years hence, and then choose that system which is better able to cope with the various classes of the demand at this future date. If he does not, it is quite possible for his municipality or company to purchase a plot of land (and probably at a high price), erect a generating station thereon, working, say, under alternating current, and in a very few years find that a continuous current station should have been originally erected, as it is more suitable to the district and better able to meet the demands of the consumers. From these few remarks you can see that it is very important that the best system should be originally installed, and my object this evening is to introduce these two current rivals before this section of the Institution of Electrical Engineers, in the hope that a vigorous discussion will ensue, from which we shall perhaps gain much benefit.

In the early days of public electricity supply it was found that an alternating current station ran as smoothly and economically as a continuous station. When we remember that the demand was very small and was only that required for lighting purposes, the reason is obvious. Public opinion was not sufficiently educated in this wonderful electricity to persuade people to place more faith in the use of it further than as an illuminant. I can imagine an electrical contractor, for instance, after having wasted time and energy, explaining to some user of mechanical power the advantages to be gained by using electricity as his motive power, receiving some such answer as this:—"I'm not going to bother with your electric motors. My machinery is running very well under steam power."

It is due to this public hostility that the use of electricity as a motive power has, until quite recently, been very limited. He was a bold man indeed who ran his machinery by electric motors. It is also very likely that the great first cost prevented the instalment of electric motors in many workshops and factories where mechanical power was already used. It is only lately that people, seeing the enormous advantages of electricity over steam and gas as a motive power, have adopted the use of electric motors, and the result of which has been that the supply companies can work with greater efficiency and consequently at a much lower works cost than before.

The rapid development of the use of electricity for both lighting and power purposes in various districts, some small, others large, has made it necessary that extensions to electricity works should be made on a very large scale, and I think I am right in saying that where there has been a fairly large demand for motive power in places originally equipped with an alternating current station, there has been no hesitation on the part of the engineers to make their extensions on the continuous current system. This is due to the difficulties they have experienced in the running of their alternators in parallel, and in keeping a steady light every time a consumer switched on his motor. I need only give two instances in support of this statement. In Bolton and Salford an alternating current system had been originally installed. Now both at Salford and Bolton the demand for motive power is likely to be very considerable, and I learn that in view of this, very big extensions are to be made at both places. Further, and more important, the extensions are to be made on the continuous current system. I have heard it said that in Salford, if a 1-H.P. motor is suddenly switched on to the circuit, the lights very nearly jump out. I refer to this again later on in my paper, when dealing with the relative advantages and disadvantages of direct and alternate current systems.

From the remarks made heretofore, I think that before proceeding further we cannot do better than turn our attention to some methods by which a district can be supplied, (1) supposing that direct current is the only possible system, and (2) in the case when our only choice is to adopt alternating current. After this we might with advantage consider the relative merits and demerits of the two systems. Let us first consider the direct current systems.

Practically speaking, we may divide an electric supply undertaking into three great sections:—(1) Generation, which includes engine room, &c.; (2) distribution, which includes mains; and (3) consuming devices.

It is not my intention to refer to the first section, except that I should like to say that the tendency now seems to be for a general acceptance of direct-driven machines in preference to either belt or rope driving. The two chief points in favour of this tendency are the economy of floor space, and also the fact that a higher efficiency is obtained. There is another point which I should like to refer to in connection with the generation of continuous current, and that is, that the current is generally generated at low tension, since in all continuous current machines it is necessary to use a commutator, which, of course, is a difficult piece of apparatus to use at high pressure.

High pressure continuous current is best obtained by the employment of motor generators, the commutator on the generator of which is built of a special kind.

Mains constitute both distributors and feeders.

Owing to the practical impossibility on the continuous current system of using transformers either in street boxes or on consumers' premises, distribution, in the true sense of the word, is only effected at low tension. By this I mean that the pressure on the service wires supplying any consumer is within the limit of low pressure set down by the Board of Trade. The reasons for this are clear when we remember that the only two methods by which the pressure could be transformed down (supposing the distribution to be at high tension) are:—

1. By the employment of a motor generator, and
2. By the use of secondary batteries.

In the first of these two methods a small current is supplied at high pressure to a motor which drives a generator, which gives out a large current at the lower pressure. The armature shafts of the motor and the generator are in the same line, and are fastened together by means of a suitable coupling.

In the second method, a number of batteries are charged in series with a small current at high pressure, and afterwards divided up and arranged so that they can be discharged at larger currents and at a lower voltage. The objections to these methods are:—

1. Great first cost.
2. Great space occupied, especially by batteries.
3. Waste of energy.
4. Requires considerable attention.

I think these few remarks are sufficient to prove that distribution on the continuous current system should only be effected at low tension. The question of how the distributing network should be fed is a very important one, and requires very careful consideration, if it is desired that the efficiency of the feeder combination should be high and the first cost low.

The duty of a feeder is to transmit energy from the central generating station to a certain part of the distributing network. As to whether high pressure or low pressure feeders be used depends solely upon two conditions:—

1. Character of district to be supplied, and
2. Relative position of generating station to district to be supplied.

In short, it depends simply upon the length of the feeders.

Now if P_G = power supplied to feeder at generating station,
and P_L = power lost in feeder,
and P_S = power supplied to district at feeding centre,
then $P_G = P_L + P_S$.

Consequently, in order that the efficiency of the feeder combination should be high, P_L must be brought as low as possible.

Now $P_L = \frac{e^2}{R}$

where e = volts lost in feeder,
and R = resistance of feeder.

Therefore $\frac{e^2}{R}$ must be reduced to a minimum.

It is evident that for short distances low tension feeders are preferable, since the drop of volts in this case is very small. But for long distance feeding (or transmission) the drop becomes very considerable, and in order to transmit at low voltage the sectional area of the conductor would have to be made ridiculously large, a circumstance which renders the thing practically impossible.

Again, the power transmitted is equal to the product of the volts (E) and current (C), so that by raising E as high as possible we reduce

* Paper read before the Students' Section of the Institution of Electrical Engineers on Wednesday, March 1st, 1899.

c to a minimum. And since the sectional area of the conductor is directly proportional to the current it has to carry, by reducing c to a minimum we are able to use a comparatively thin conductor.

I think these remarks prove sufficiently the economy of using high tension feeders in cases where the distance between the generating station and the feeding point is great, (say, for distances over 1¼ miles).

Now a continuous current machine is incomplete without a commutator, and since it is very likely that the insulation on the commutator will break down if the pressure exceeds about 3,000 volts, it is at once apparent that the tension on our feeders is limited. Hence in continuous current systems the working pressure on the high tension feeder cannot exceed about 3,000 volts.

In continuous current stations the current is generated at low tension; consequently, in the case of low tension feeders the station ends of the feeders are connected direct to the switchboard which also is connected direct to the machines, and the far ends of the feeders are connected direct to the supply circuit. But in the case of high tension feeding, the large current which is generated at low pressure is transformed by the aid of a motor generator into a small current at high pressure. This small current at high pressure is then transmitted by the feeders to the feeding points on the distributing network. But here the pressure has to be transformed down. This again is accomplished by the aid of motor-generators which are placed in sub-stations, or, better still, fixed in buildings erected above ground, since the atmosphere in all underground stations is very damp, a circumstance which is not very desirable in rooms containing high tension apparatus.

Of course it is theoretically possible to employ a battery in connection with high tension feeders, but owing to the great first cost and enormous space required, coupled with the low efficiency, such an arrangement is practically impossible.

But a battery may be used to advantage if it comprises part of the generating plant at the central station. By means of this arrangement an engineer is able:—

(1) To charge the battery during the day and discharge it during the night, thereby enabling the engine room to be shut down during the greater portion of the night.

Or (2) to charge the battery during time of light load, and discharge it during the time of heaviest load.

These two advantages certainly justify an engineer in using a battery station in connection with his generating plant.

Having now arrived at something like definite conclusions as to the method of distributing electrical energy from a continuous current station, let us now see how we can supply the demand of various districts.

Earlier in the paper I stated that continuous current distributors should only run at low tension, consequently it now only remains to take the case of different districts and see what is the best system for feeding these districts, *i.e.*, whether at low or high tension.

The table below gives the various districts and what I think is the best system of feeding these several districts. There is also a column giving the position of the generating station with respect to the area to be supplied.

District to be supplied.	Position of station.	Distribution.	Feeders.
1. Consumers congregated together in small area.	In area of supply.	Low tension only.	Low tension only.
	Out of area of supply.		High tension only.
2. Consumers scattered over a large area.	In area of supply.		High and low tension.
	Out of area of supply.		High tension only.
3. Combination of 1 and 2.	In area of supply.		High and low tension.
	Out of area of supply.		High tension only.

Before leaving this part of the paper I should like to refer to the two, three, and five-wire systems of distribution, to each of which the above table is applicable.

Now, in the two-wire system, the distributors consist simply of two conductors, positive and negative; therefore, in streets where the demand is large, a big load has to be carried by these two conductors.

Moreover, the supply must be able to meet the demand required for both incandescent and arc lighting, and also motors.

For incandescent lighting the pressure cannot exceed 230 volts, since this is the pressure of the highest voltage incandescent lamp, while, for arc lighting, a consumer would be compelled to burn two arcs in series unless he wasted half of the energy in a resistance, there not being an arc lamp on the market yet that will work at this high pressure. Undoubtedly, the pressure for motors generally should never be less than 400 volts. It is impossible for a two-wire system to supply at, say, 230 volts for lighting and 400 volts for motors. A user of the two-wire system might say that motors could be wound for 230 volts. No doubt they could, but by so doing the current supplied to the motors is then practically doubled. The size of mains must be large enough to carry the current. Therefore it means an increase in the cost of mains, and the cost of mains is always the heaviest item in connection with electric supply works.

Briefly we may say that the disadvantages of the two-wire system are:—

1. The impossibility of supply at more than one declared pressure, thus rendering the system *not* suitable for a public electric supply.
2. The enormous cost of mains, due to the large sectional area.

When we think of the increase in the various classes of demand, these disadvantages, I think, afford sufficient proof to show that before very long two-wire systems will be entirely obsolete, multiple wire systems being adopted.

There are very few stations in the United Kingdom supplying on the two-wire system. There are only about 17 out of a total number of 70 continuous current stations. The remainder are three-wire, with the exception of Manchester, which employs five-wire for the denser portions of the city, and three-wire for the districts outside the city.

The advantages of the three and five-wire systems over the two-wire are—

1. It is possible to supply consumers at more than one declared pressure.
2. Great saving in copper, due to the fact that distribution can be effected at a higher pressure.

In the three-wire system the pressure on the outers is generally 200 or 400 volts. If 200, it is possible for a consumer to receive electrical energy at either 100 or 200 volts. If 400, he is supplied at either 200 or 400 volts.

It is more efficient to use a 200-volt lamp than a 100-volt. Further, the pressure supplied to motors, especially large ones, should never be less than 400 volts. Therefore, I think that a three-wire system with 400 volts on the outers is superior to a three-wire system with only 200 volts on the outers. Moreover, the cost of the mains in the former case will be one-fourth that of the latter, due to the great saving in copper effected since the distribution is at double the voltage.

(To be continued.)

ON WORKS' ORGANISATION.*

By TOM WESTGARTH.

This paper is prepared mainly for the consideration of marine engineers, but many of the remarks will refer to shipyards and manufacturing works generally. It is not intended to be a paper in the ordinary sense of the word, so much as a basis for discussion.

Before laying out a works, it is important to determine as far as possible not only the kind of work to be done, but the size of the work, and speaking generally, it is better to keep to somewhat narrow limits, rather than to try and adapt the works for many kinds of manufacture. The designs will be quite different if it is proposed to make a speciality of small engines to what they would be if engines are to be built for ordinary cargo boats; still more, if it is intended to build machinery for the largest class of steamers. There is necessarily a limited demand for the largest class of work, and as the buildings and machinery must be large and very expensive to deal with large engines, it is not wise to put down a factory for this class of work unless it is clear that a continuous supply of orders for large engines can be secured with some degree of certainty. Speaking generally, the writer thinks it is also well not to attempt to make machinery and parts of engines which are a speciality of other makers, as, for instance, it is probably cheaper to buy pumps and auxiliary engines than to make them. The writer is not sure that it is wise for engine builders even to make their own castings, and the experience of the principal Scotch engine builders appears to point to the wisdom of buying castings. It will generally be found advantageous also for engine builders to buy their forgings, as a forge can only be made to pay if kept full of work, and few engine works can keep a forge supplied with work for their own requirements.

Another very important matter to be considered in laying down an engine works is the site to be chosen. This must be done with great care; the primary condition, of course, being that the works should be in the neighbourhood of shipbuilding yards, and should adjoin a wharf where ships of any size can be fitted out. There should also be access to the works by rail, and railway lines or tramways should be laid in all parts of the works; care should also be taken that there are plenty of powerful cranes; few things help more in keeping down the cost of labour than good crane power and means of quick transit.

Workshops should be as large and open as possible; all small rooms and dark corners should be carefully avoided, and every shop should be as light as possible both by day and night. In placing tools, care must of course be taken that the rotation of work should be continuous. The writer is satisfied that the plan frequently adopted of grouping similar tools together, as, for instance, having all planing machines in one part of the shop and all drilling machines in another, is not always satisfactory, and sometimes involves unnecessary labour in carrying work to the machines. The tools should not be placed in groups of one kind, but with a view to the particular work which will be done in conjunction with other machines. It of course requires no argument to show that the best modern labour-saving machinery must be procured, but the writer is inclined to think that too much money is sometimes spent on special tools, and also in the way of duplicating tool boxes, head stocks, &c. It may be very frequently observed that where a machine is fitted with two or more heads, one only is in general use; this remark refers to tools which are being worked on piece as well as time, showing that the workmen find that they can earn more money by giving their whole attention to one tool.

One of the most important departments of a works is the tool store, which should be placed in a central position and carefully

* Read before the North-East Coast Institution of Engineers and Shipbuilders in West Hartlepool on Saturday, January 21st, 1899.

organised and worked. All tools, gauges, templates, working drawings, &c., should be kept in the tool store, which should be kept in charge of a tradesman who will make special tools, and will have under him a staff of men who repair and keep in order all tools, and will also make gauges and templates, and issue and keep a record of the working drawings.

It is important when starting new works, or altering and reconstructing old ones, that manufacture should if possible be suspended until the works are entirely ready for use. After taking into consideration the possible loss of customers and trade, the writer is of opinion it is still cheaper to suspend manufacturing operations during important alterations of an old establishment, or not to commence manufacture in new works until everything is ready, rather than to try and carry on manufacture during the alterations, or to commence before the new works are complete; and even with every precaution in this way it will be found as a rule that no new works can commence manufacturing at a profit.

With regard to the staff, it is quite as important that the staff should be both sufficiently good and sufficently large for the work to be done as to have a well laid out works with good machinery. It is of course easy to err upon the side of having too large a staff, but a very much commoner error is to have the staff too small. It is impossible to calculate the loss in a shipyard or engine works which will take place if the drawing office is undermanned and the works behindhand. It is only possible to manufacture cheaply if materials are got in, not only correctly, but in good time. It is upon this question of staff that masters frequently err. Most capitalists quite agree as to the necessity of having the best tools, and plenty of them, but the writer is afraid the majority consider that a large staff is a waste of money. Not only is it important that the drawing office should be well manned, but also the commercial office, and particularly the cost-keeping department. It is of vital importance that the costs should be kept up to date, and an abstract of costs should be furnished, if possible, weekly, and made up to the end of the previous week, to the responsible managers, so that they may know how costs are progressing To have this information whilst work is in progress, and when it is not too late to make an effort to reduce the cost of the job if it is becoming too high, must be of infinitely more importance than to have the information when the work is finished. This, however, can be done only by having a large and efficient staff.

Another point upon which capitalists and practical men sometimes do not agree, is as to having work finished before it is required. It is true that there will be some loss of interest, but this is much less than the loss which would be incurred if the work is behindhand and has to be finished in a hurry, sometimes regardless of cost. The cheapest way to build engines is to have as many repeat orders as possible, and to have the work on order as long as possible before it is required, so that it may be laid out to fit in with other work; thus a duplicate engine may sometimes be built 10 per cent. cheaper by being put through the works with its fellow, although it must be ready two or three months before it is required, and the saving will be much more than pay for the loss of interest on the capital standing idle.

The writer is satisfied that modern developments and the present day system of very large works, often controlled by non-resident directors, has been the cause of losing much efficiency through the loss of the personal contact between masters and workmen, and he thinks that everything that is possible should be done by those having the control of large works to foster a friendly spirit between masters and workmen. This can of course only be done satisfactorily if the advance is made from both sides, but necessarily the first steps must be taken by the masters. He is also of opinion that more attention might be given to the consideration of profit-sharing, notwithstanding the poor results which have followed efforts in this direction in this district, and he invites the members of this Institution to discuss this subject fully this evening.

One of the most important matters in conducting a manufacturing business is the selection of works' managers and foremen. There are probably few more difficult positions to fill than that of works' manager, because there must be a sufficient firmness to ensure obedience and respect, and yet there must be a feeling on the part of the men that the manager is their friend. The writer is afraid that many works' managers consider too much the former qualification; on the other hand, if the manager is not very firm, sometimes even to harshness, there is often an unworthy advantage taken of him by the workmen. The writer is of opinion that foremen, upon being appointed, should certainly cease to be members of trade societies, and make some other arrangement for provision against sickness, old age, &c. He does not think that foremen, as a rule, knowingly allow the influence of trade societies to have weight with them, but it is contrary to nature that they should be able to act entirely independently of the society of which they have been a member for many years.

The writer considers that more attention should be given to the selection and training of apprentices than is often the case, and that the rules as to apprenticeship, non-membership of trade societies, attendance at night classes, &c., should be more carefully drawn, and more strictly adhered to. To this end he is inclined to think that the old system of binding apprentices might with advantage be reverted to. More care should be taken with premium apprentices, premiums should be reduced, and premium apprentices should be compelled to adhere strictly to the rules of the works in which they were engaged. He is also of opinion that a class of excellent foremen might, in course of time, be formed from premium apprentices if more care were taken in their training.

The writer strongly recommends the principle of payment by results, from the managers to foremen and workmen. Managers should be paid partly by a percentage on the profits of the works or of their department; foremen should be paid partly by a bonus upon the quantity of work turned out, providing always that it is satisfactory, and workmen should be paid by piecework, which should, if possible, be supplemented by the comparatively new bonus system, and he sees no reason why apprentices and boys should not also work by piece.

The writer looks to the gradual, careful, and persistent introduction of the system of payment by results, as being one of the most hopeful means by which we shall be enabled to hold our ground against foreign competitors, and he is of opinion this question is one which will bear very careful consideration and discussion.

It should be clearly grasped by capitalists that the days of very large profits from engine building are past. The competition for work is now so great, and the standard of requirements so high, that it is only in good years that a large profit can be made; and experience has taught us that trade fluctuates so much that good years are invariably quickly followed by bad ones, and therefore, when a large profit is made, it should certainly not all be divided, but part should be kept for a reserve fund to equalise dividends in bad years. If an engine works can pay steadily 5 per cent. on the capital, and gradually accumulate a reserve fund, after making proper provision for depreciation, and taking care to buy new machinery and tools, and also make minor extensions from revenue, capitalists should be satisfied that the investment is a good one, and if such a policy could be carried out, there would be much less difficulty in getting capital subscribed for manufacturing purposes. Manufacturers are not entirely free from blame for the present peculiar way in which the investing public will much more readily put money into mines and all kinds of speculative investments abroad rather than into shipbuilding and engineering companies at home.

The following suggestions are made as to a few points for discussion, viz.:—

1. Payment by results, including piecework.
2. Profit-sharing.
3. Best means to ensure a friendly feeling between masters and workmen.
4. Does a large staff pay?
5. Qualifications for works' managers and foremen.
6. Binding apprentices.

CHARGE AGAINST A CONSULTING ENGINEER.

Henry Cleaver, giving his occupation as consulting engineer, was brought up at Cheshire under a warrant charging him with obtaining the sum of £1 1s. by false pretences from Messrs. Stanley, Davies and Pollard, electrical engineers, of Hyde.

The Chief Constable, in explaining the charge to the Bench, said that in February Mr. Pollard noticed an advertisement in the Electrical Review, which asked for specifications for some electric installation. The specifications would be sent on receipt of a cheque, which was to be returned upon the receipt of a *bonâ fide* tender. Mr. Pollard sent on the guinea, received a specification in return, and afterwards sent on the tender. He did not receive the guinea back, but afterwards got a letter asking for a further £25 on certain conditions. Mr. Pollard made inquiries, and found that the address given by Cleaver was a lodging house, and he was not known. From inquiries he (the Chief Constable) made, Mr. Pollard obtained a warrant, and the prisoner was received into custody from the Southampton police on Wednesday. There were found 109 other letters relating to transactions of a similar kind, and the Southampton police had sent word that they had received other complaints. He would submit formal evidence, and ask for a remand.

Councillor James Pollard, J.P., said he was an electrical engineer, carrying on business at Hyde, under the name of Stanley, Davies and Pollard. He saw an advertisement in the Electrical Review on February 3rd. In accordance with the terms of the advertisement he sent down a cheque for a sum of £1 1s., to be made payable to H. Cleaver, whose address was given as 52, Bridge Road, Southampton. The envelope was addressed to "H. Cleaver, consulting engineer, 52, Bridge Road, Southampton." In reply, he received the specifications produced, which purported to be for an electric plant to be supplied and erected in the neighbourhood of Reading, Berkshire. There was no name given of the firm for whom it was to be erected. He could not swear whether there was any letter accompanying the specifications. When witness received the specifications he got out a tender, copy of which was produced. He sent it on to H. Cleaver, at the above address. The reply he got to that, on Friday last, was now produced. In this reply Cleaver said he was prepared to place the order for the electrical installation with witness's firm upon condition that they sent a cheque for £25, the contract to be signed by his (Cleaver's) clients and their's within 14 days from the acceptance, otherwise the £25 would be returned to them, and the whole matter considered void, unless otherwise arranged. Upon receipt of the cheque for £25 he would at once have the contract drawn up and sent to witness for perusal, and at the same time make an appointment for a personal interview with witness, so that they might discuss all the details. When witness got that letter his electrician wired saying they would accept the terms. The letter aroused witness's suspicions, and he caused certain inquiries to be made through his bankers. As a result of the inquiries, he wrote a letter to Cleaver, and he had the reply in Court. His letter to Cleaver ran as follows:—"Dear Sir,—In accordance with our telegram we are prepared to send on cheque for the sum you state in your letter, if you will give us the name of the company putting down the plant, also reference, as we cannot find your name

as a consulting engineer. We are hoping to do business with *bonâ fide* firms, and should like to know the names of the firm we are treating with." Then witness received the following reply:—"Dear Sir,—In reply to your letter this morning, I hope to be in Manchester in the middle of the week, and will call upon you."—Yours faithfully, H. Cleaver." In consequence of that letter witness consulted with the Chief Constable, and last Sunday took out a warrant.

In answer to the Magistrates' Clerk, Witness said there was no authorised list of consulting engineers. Any man who was an engineer could call himself a consulting engineer. There were directories containing the names of most of the consulting engineers in the country, either electrical or mechanical, but he could not find Cleaver's name in two that he looked through. The cheque for £1 1s. had been cashed.

The Magistrates' Clerk asked prisoner if he had any questions to put to the witness.

Prisoner: What Mr. Pollard has stated is quite true.

Prisoner was proceeding when he was told not to make a statement then.

Prisoner (to witness): If the guinea had been returned, the whole question of fraud would have been settled?

Witness: No, in connection with the letter we received on Friday.

Prisoner: But in connection with the present charge?

Witness: I cannot speak about that.

The Prisoner: The charge is of obtaining a guinea under false pretences; therefore, if the guinea had been returned, there would have been no false pretences?

Witness: It is usual for guineas to be returned. Three electrical engineers we have worked under have never cashed our cheques, but simply held them as a guarantee of the *bonâ fide* character of the tender, and returned them when the contract has been let.

Prisoner: Still, for all that, I think if the guinea had been returned the question of fraud would have been dropped, would it not?

The Magistrates' Clerk: This is a public matter, and I don't think it is in Mr. Pollard's power. It will be for the magistrates to determine it on the evidence. Any other question?

Prisoner: No. I ask you to make a note of my question.

Witness: In that case I shall want a note making of my reply to the question.

Magistrates' Clerk: Oh, certainly.

Detective Sergeant Dixon, of Hyde, stated that he received the prisoner into custody from the Southampton police at 2.15 on Wednesday, and had handed over to him 109 acknowledgments of a guinea each from electrical engineering firms. He read over the warrant to prisoner, and cautioned him. In reply prisoner said, "It's all right."

Magistrates' Clerk (to prisoner): Do you want to ask this witness any questions?

Prisoner: No.

The Chief Constable asked for a remand for a week.

Magistrates' Clerk (to prisoner): Have you any objection to a remand?

Prisoner: I ask to be released on my own recognisances, to go back to Southampton, and arrange all the matters. You see there are a large number of applications, and directly this gets into the papers everyone will come up here, and it is going against me. I can return these guineas. I will report myself to the Chief Constable there, and return when required. It will be absolute ruin to me if I cannot go down and do my business there—absolute ruin.

Mr. H. Bostock, solicitor, at this stage said he was instructed by the prosecution, and his instructions were to oppose the granting of bail unless it was made substantial. Having regard to the admissions made by the prisoner, it was of the utmost importance that if bail was granted it should be substantial.

The magistrates consulted for five or ten minutes, and just as the chairman was about to speak,

The Prisoner said he could have gone away for a month or two, but had not done so, although last week some inquiries were going on.

The Chairman: You had better reserve your remarks for some other time.

The Prisoner: You see it means absolute ruin to me if I cannot get back.

The Chairman: We have agreed to adjourn the case until next Thursday, and will allow bail on condition you bind yourself in £50, and obtain two sureties of £50 each.

Prisoner: I cannot find sureties. If you will allow me bail in my own recognisances I will do anything that way; but I cannot find the sureties in time. Isn't there any chance of that being done?

The Bench replied in the negative, and prisoner was removed to Strangeways Gaol.

WATER SOFTENING.

While it is certain that water softening is a most important subject, and should engage the attention of every steam user who may be using hard water, it is equally certain that the subject has been badly treated.

Vendors of water softening apparatus have attempted too often to make a mystery of the art, and have indulged in a good deal of rank charlatanry. Some waters can be softened completely, others can be equally well softened completely, but at the cost of introducing other elements into solution. A water containing only carbonate of lime may be very completely softened. Waters containing lime sulphate can be softened, but belong to the second class. There are waters which are so charged with mineral matter of an undesirable nature that, after being softened, the water contains more salt in solution than it had before softening. It is softened in the sense that it will not at once deposit a scale on the boiler, but it is not purified. In the removal of sulphate of lime, for example, soda is employed. This is in the form of the carbonate. The reaction which occurs is that the acids in the two salts exchange their bases. The sulphate of lime becomes carbonate of lime, which is insoluble, and is therefore deposited, while the carbonate of soda becomes sulphate of soda. Now, sulphate of soda is a very soluble salt. It does not deposit out, and the water is said to be softened because it is deprived of scale-forming matter; but it is not entirely cured. According to Gay-Lussac, 100 parts of water at 0° C. will dissolve five parts of anhydrous sulphate of soda. At 103° C. the salt is soluble to the extent of 42 parts per 100 of water. This salt is clearly very soluble indeed, and water containing it may be concentrated considerably without the salt crystallising out. But if a water containing lime sulphate is softened, and this sodium salt is formed in its place, the continued use of the boiler with constant feed water being pumped in will soon bring into the boiler a large weight of sodium sulphate, and unless the boiler be blown out occasionally the salt will crystallise out and very seriously endanger the plates. Hence the need of care and the use of intelligence, otherwise a wise precaution may lead to disaster. Some water is so pure that boilers may be worked for months and not blown out, but as a rule waters available for steam purposes are hard. An article by Mr. W. N. Twelvetrees appears in *Cassier's*, in which the various types of softening apparatus are illustrated and described.

All are practically based on the Porter-Clark process. The essence of this process, which is suited only to waters containing carbonates, is contained in the fact that carbonate of lime or magnesia—two of the more usual impurities in water—are insoluble unless in the presence of carbonic acid gas. It would be more correct to say, perhaps, that the carbonates are insoluble, and that the more usual impurities are the bicarbonates of lime and magnesia. The additional molecule of carbonic acid gas is, however, loosely combined and may be separated by moderate heat or by some substance which more readily combines with it. Dr. Clark, after whom the process was named, found that the addition of caustic lime in proper quantity to a bicarbonate of lime solution—a hard water—gave rise to carbonate of lime. The soluble lime absorbed the loosely-combined carbonic acid gas and became converted into the insoluble carbonate, while at the same time the soluble bicarbonate, now deprived of its excess of carbonate acid, became also the insoluble carbonate.

Chemically, the change is thus expressed:—

Lime.	Bicarbonate of lime.		Carbonate of lime.
CaO	$+ CaCO_3 + CO_2$	$=$	$2\ CaCO_3$

Both the caustic lime and the bicarbonate are precipitated as insoluble carbonate. Dr. Angus Smith, who reported on the question many years ago for the Manchester Steam Users' Association, pointed out that the process was useless for treating sulphate of lime, and he showed that to treat this salt which is soluble at higher temperatures than the bicarbonate it is necessary to employ soda, or, rather, carbonate of soda. In the reaction which then takes place we have—

Sulphate of lime.	Carbonate of soda.		Carbonate of lime.	Sulphate of soda.
$CaSO$	$+ Na_2CO_3$	$=$	$CaCO_3$	$+ Na_2SO_4$

Here, again, carbonate of lime is formed and is deposited, being insoluble, and sulphate of soda is left in solution, being exceedingly soluble and non-scale forming.

The two bases exchange their acids.

Dr. Angus Smith observed, however, that if a water contains both salts of lime—the bicarbonate and the sulphate—the bicarbonate of lime may first be reduced to insoluble carbonate by the use of caustic soda in place of caustic lime. This first reaction gives carbonate of lime and carbonate of soda, or—

$$(CaCO_3 + CO_2) + Na_2O = CaCO_3 + Na_2CO_3.$$

The lime is deposited as carbonate and the carbonate of soda then remains to carry on the reduction of the lime sulphate. Probably the electric method of caustic soda manufacture may assist by reducing the cost of caustic soda, to revive this beautiful double process, which can be employed for water containing the two scale-forming salts, by calculating the ratio of soda to caustic lime necessary to produce the reactions; otherwise the bicarbonate of lime may still be removed by caustic lime and the lime sulphate by carbonate of soda, each salt being treated on its own basis only.

Water softening in its crude form, which is as effective as any other, consists in simply thoroughly mixing the correct weight of lime or soda in a large tank of the water to be softened, and allowing time for the reactions and precipitation to take place. In a tank 6 feet deep, every particle separated out must deposit through 6 feet of water, and occupy quite six times as long as if the tank were only 1 foot deep. But space cannot be spared for this system as a rule, and apparatus is employed which, in effect, controls the movement of water, and reduces the depth of water through which sedimentation has to take place.

In the Stanhope apparatus described there are three vertical cylinders. One is fed with lime and water, and a stirring chain is kept in motion through the lime, and over a wheel at the top, to keep the lime agitated. The water thus limed to saturation, or one part in 730 of water, passes to a mixing tray, and meets the remainder of the water to be treated, and thence overflows to a second vertical cylinder in which it deposits some of its mud and passes over to a third larger cylinder, up which it flows slowly through a set of perforated cones in which it deposits most of its remaining mud, finally rising through a filter and escaping to the storage tank. The propor-

tion of saturated lime water to total water is regulated by a valve. Soda when added is regulated by means of a hydrometer which opens or closes the supply valve according to the density of the soda solution, which cannot be so easily regulated as the lime because soda is so very soluble. The operation is accelerated by heat which no doubt assists to split up the bicarbonate of lime.

The Chevalet apparatus is one which depends partly on heating the water to the temperature at which bicarbonate of lime deposits and adding soda to deal with the sulphates.

In the Howatson apparatus the process is performed alternately in in two vessels. In the Brunn apparatus used on the Continent, the caustic lime is used as milk of lime, but in all these processes there is no difference of principle, merely variation of apparatus.

The Archbutt-Deely system, as worked by Messrs. Mather and Platt, introduces a novelty in the shape of a recarburator. Some people claim that softened water, which still contains a little lime, deposits some of this very readily, and to avoid this action, which causes speedy choking of pipes, it is arranged that carbonic acid gas drawn from a coke furnace is pumped in fine streams through the softened water, which is thereby recarbonated, and any slight amount of lime is rendered more soluble.

The water is in a sense again naturalised without, however, the addition of any lime. It may be stated generally that iron dissolved in a water will be removed by the Clark process, and this property renders it exceedingly useful for dyeworks. Indeed, it is to their care in softening water that foreigners have been so successful in wool dyeing, and a Yorkshire dyer who used softened water informed the writer that he could get 6d. per lb. more for dyeing soft wool yarns of the Berlin wool description than anyone else, and he said he did not fear the foreigner, for he had as good water as anyone. London's daily water supply contains 160 tons of carbonate of lime, and Londoners pay £250,000 per annum more for soap than necessary. So it is stated by Mr. Twelvetrees. We believe he very much underestimates the loss, for we were told of a large asylum where the use of softened water saved 6s. 8d. per head for each inmate per year. As much water may be softened for 1d. as will destroy soap to the value of 3s. 8d.

Dr. Frankland states that for 20s. over a million gallons of water can be softened. This is at the rate of about a farthing per 1,000 gallons. The present writer, to be on the safe side of an argument, is accustomed to state the cost at less than 1d. per 1,000 gallons. Apart from the power of using a cheaper supply, the use of soft water is a saving in fuel. It obviates overheating of boiler plates, avoids chipping plates, saves the excessive use of the blow out, and abolishes any possible reasonable objection to the economiser and its 15 per cent. of economy in fuel.

Indeed, water softening should almost invariably be found successful. It is a simple matter to find by analysis when it will not be successful. The chemistry of feed water does not end with the lime salts described. There are the chlorides sometimes to be dealt with. They are dangerous salts, as no doubt some of the electrical works on the Thames have found out, for the chloride salts are apt to decompose at modern high temperatures, and to form hydrochloric acid which quickly eats through plates and tubes.

Such waters are sometimes dealt with by means or other reactions, all depending on the transference of the acids and bases in a manner to secure the precipitation of a salt or the formation of another more stable salt and highly soluble. As stated, there are waters which it is almost, or quite, as well to leave alone. Such a water is obtained in Yorkshire, from the Thornhill Rock, one of the rocks of the carboniferous series near Wakefield. This rock yields water which cannot be treated by any known practicable systems for deposition, and when treated its load of soluble salt is enormous—so much so as to constitute a danger in a steam boiler from evaporation and concentration. But such waters are comparatively scarce, and as a rule it pays to employ a softening system.

GAS ENGINE ECONOMY.

It is pointed out by an American writer that there is a different system of gas engine governing growing up in America from that prevalent in Europe. The European system is the well-known hit-and-miss type, which omits an explosive charge altogether when the speed of the engine exceeds a given number above the normal, and puts in every possible explosion as soon as it falls below the normal by a given percentage. This system is the more economical. In America the regulation is effected more on the system followed in steam engines, by omitting a portion of the gas. The charge of gas is regulated, but is never entirely shut off. The system is less economical than the former, but it enables the range of speed to be kept within much narrower limits, and is, so far, a distinct improvement on the European method, and we think it might well be considered. In a steam engine no one ever appears to think of regulating the power other than by varying the amount of steam admitted. There are no idle strokes. Too much value is placed on regularity of turning effort to admit of a hit-and-miss method of regulation, although it is quite possible that such a method might be more economical than any system of cut-off or throttling regulation.

It is possible that the employment of the economical method in Europe has arisen partly because the European gas engine has been, so to speak, nurtured on somewhat expensive coal gas, and economy has appeared necessary. In America, coal gas has been so very expensive that gas engines have made but little progress until they have been perfected in Europe, and producer gas has been applied. Now, producer gas is cheap, and it is comparatively very cheap in America—comparatively, that is, as regards the cost of lighting gas, and there has been less cause for studying economy of the fuel and more cause for studying speed regularity. Hence the preference for gas regulation on lines of turning regularity.

This is especially desirable in electrical work, for which an extremely steady speed of rotation is so desirable. The cheapness of producer gas and of blast furnace gas should tend to the use of the system of regulation rather than hit-and-miss. With the cheaper gases named it is very doubtful if the economy of hit-and-miss methods can be compared with the convenience of better turning. Indeed, though heavy fly-wheels are always desirable from the point of view of steady turning, it is possible that the weights of these friction producers might in some instances be so reduced as to make up at least a part of the losses of the regulation.

For installations of several units, in which one unit only may be working at a varying rate, leaving the remainder always at full power, the loss by gas variation in the one engine will form a very small fraction of the total gas consumption, and in such case practically all objection to the less economical system of governing disappears.

As is often the case where an invention has been slow in being adopted, it appears that the gas engine is now going rapidly ahead in America. There are a large number of makers, and some of the engines are very nicely made, run well, and are commendably simple.

ACETYLENE GAS ACCIDENTS.

By JOHN B. C. KERSHAW, F.I.C.

The issue of the *Journal of Acetylene Gas Lighting* for January, 1899, contains a reprint of the report by the present writer upon the "Calcium Carbide Industry in 1898," which appeared in the columns of this paper three months ago. The editor of the *Journal of Acetylene Gas Lightiny* in the issue which contains the reprint, criticises this report somewhat unfavourably, and especially condemns as unfair the following paragraph:—

> That acetylene gas will prove, under certain conditions and in certain situations, a useful lighting agent, he (the writer) does not doubt. It has, however, to meet as rivals, coal gas, oil, and electricity; and since the first two of these are, when burnt under the best conditions, cheaper illuminants, and the latter is much more convenient, acetylene gas can have but a limited field of usefulness. At present its adoption, even in this limited field, is hindered by the tendency of acetylene burners to smoke, and by the frequency with which fatal explosions are produced on the part of ignorant users of the gas. These hindrances are doubtless only temporary in character, but at present they exist, and cannot be left out of account.

It is unnecessary to enter into a discussion of the question whether the writer, or the editor of a journal devoted to pushing acetylene gas, is likely to be the more free from bias in forming a judgment upon the commercial prospects of that gas as an illuminant; but it may be useful to give a summary of accidents with *Acetylene Gas* which have come under the present writer's notice in the course of the last two years. No special effort has been made to collect complete statistics on the subject, and it is probable that other accidents have occurred, the reports of which have escaped his attention.

1. Explosion of *Acetylene Gas* at Egremont, in Cheshire, killing the experimenter, who had been using an acetylene gas engine.—March, 1897.

2. Explosion of *Acetylene Gas* at the Carbide Works at Prémont, near St. Michel de Maurienne, killing one man, injuring three, and wrecking the works.—(Reported in *L'Industrie Electrochemique*, Vol. i., p. 47).

3. Explosion of *Acetylene Gas* at Dayton, U.S.A., caused by a flood and liberation of the gas from stored carbide.—March, 1898.

4. Explosion of *Acetylene Gas* at Delaware, U.S.A., while charging a generator. One man killed.—December, 1897.

5. Explosion of *Acetylene Gas* at Lynn, in Norfolkshire, while charging a generator, killing one and injuring another.—December, 1898.

6. Explosion of *Acetylene Gas* at Netherseal Colliery, Ashby-de-la-Zouch. Building containing the plant wrecked, and one man killed.—January, 1899.

7. Explosion of *Acetylene Gas* in Laboratory of French War Office, during experiments upon use of mixtures of acetylene and compressed inert gases for illuminating purposes. No one seriously injured.—March, 1899.

These are all accidents caused by explosions of mixtures of acetylene gas and air; had those resulting from the use of liquid acetylene been included, the number would have been doubled, and the fatalities increased fourfold.

The accidents at Delaware and at Lynn are stated specifically to have been caused by inclusion of air when charging the generator, and that at Ashby-de-la- Zouch was probably due to the same cause.

Those who have any experience of work with gases which form explosive mixtures with oxygen, will know that many of the forms of acetylene generators invented ! ! during the last three years are in the highest degree dangerous, and there is some cause for surprise, in view of the reckless way in which companies for manufacture and sale of acetylene apparatus have been floated, that a larger number of fatal accidents have not occurred. Many of the generators require intermittent supplies of carbide. This carbide can only be introduced through an opening which may *admit* air into the apparatus. Every charge of carbide may thus lead to the creation of conditions inside the generator, which only require the presence of a light to produce an explosion.

The decision of the committee appointed by the Society of Arts only to permit the use of generators complying with certain specified regulations at the Acetylene Gas Exhibition in London last July, proved that unsafe generators were being manufactured and offered for sale. The action of that committee, and the awards they made, undoubtedly tended towards the safety of the general public. There are still, however, far too many ignorant people engaged in the invention and use of acetylene generators, and it would be well if those who desire the calcium carbide industry to develop in a healthy manner would warn such people of the dangers that attend the use of badly designed generators, and the unscientific use of even safe forms of apparatus.

In conclusion, may the writer be allowed to point out that the editor of the *Journal of Acetylene Gas Lighting* might with advantage devote portion of his paper each month to the enlightenment of his readers on this subject.

As a first step in this education of the ignorant, he might reprint the present article. The list of fatal explosions of acetylene gas would doubtless be interesting to his readers; for, so far as the present writer is aware, only *one of these* explosions (that at Lynn) has received notice in the *Journal of Acetylene Gas Lighting*.

This neglect of such interesting and educational copy is certainly unwise.

THE VICTORIA ACCUMULATOR.

[BY A CONTRIBUTOR.]

A PERUSAL of the report on this accumulator, which appeared in your issue of 14th inst., suggests the following remarks, viz. :—

From the discharge curves and figures of the cells "D" and "B," which are of equal weight, it is evident that their behaviour is not uniform, for while cell "D" at an average discharge rate of 29·773 amperes gave 409 watt-hours, cell "B," at the lower rate of 24·18 amperes, had a capacity of only 387 watt-hours, and this, although the discharge was continued until the voltage had dropped below the level at which the discharge of cell "D" was stopped. At another test it was found that one element had at a discharge rate of 40 amperes a total capacity of 168 ampere-*hours*, or 11·59 ampere-hours per kilo. total weight, while another at the higher rate of 53·5 amperes gave 13·6 ampere-hours per kilo. total weight.

The example which is given to show that "the efficiency of the Victoria accumulator diminishes very little in proportion with an increase in the rate of discharge," corroborates the above conclusion, for it is unlikely, and opposed to known facts, that the efficiencies at so widely different rates of discharge as 1·36 amperes and 5·25 amperes per kilo. ("of energy" is evidently a printer's error) should be practically the same, viz, 77 per cent. and 76 per cent., while at a discharge rate of 8·15 it drops suddenly to 50 per cent. To enable a comparison with other types, the rate of charge should also have been given.

A comparison is made with the Fulmen accumulator, but I do not think that the deductions derived therefrom are conclusive. Although one type may have thicker plates than another, it does not necessarily follow that the mechanical strength of the former is greater, nor that its cost of maintenance is less and its life considerably increased. Such assertions can only carry conviction when based upon lengthy trials under actual working conditions. The time test is all the more essential with a type in which the lead oxides are mixed with some substance which is intended to serve either as the binding material or to increase either the voltage or the capacity, as past experience has shown that such admixtures of an inorganic or organic substance, although sometimes quite satisfactory at the beginning, are generally disintegrated or converted by the electrolytic action with detrimental results to the accumulator.

Possibly, however, the carbides contained in the active material render it permanently superior both to a paste made of lead oxides or salts alone, or to similar processes previously employed. If figures relating to lengthy tests are available, their publication would prove of service, and if the results are as favourable after the cells have been at work for, say, six months, as those shown in the report, then there would seem very little reason to doubt that the Victoria accumulator is very valuable for traction purposes, and that the success of this type may reasonably be considered as certain.

DANGEROUS TRADES.

A SERIES of articles has recently appeared in the *Trades Unionist* on the above subject. Number IV., dealing with electrical generating works, is written by Mr. G. W. Partridge, of the London Electric Supply Corporation. After a brief introduction he says: "An electrical generating system may be divided into the following heads: (1) The dynamo or generator itself; (2) the collector or commutator of generator; (3) the switchboard; (4) mains or cables; (5) distributing stations or transformers, and apparatus fixed in consumers' premises or in boxes under the streets." The article is written in a popular manner for a non-technical paper, but it is scarcely correct to call mains and transformers part of "an electrical *generating* system," although it is part of an electrical *supply* system.

The dynamo or generator is disposed of in less than a dozen lines, as the author states that "There is very little danger of the attendant getting a shock here, the chief danger being that of falling against the revolving part, which may be prevented by proper guard rails placed round the machine." This appears to take it for granted that the armature rotates as in a badly constructed alternator with a fixed armature, the terminals may be exposed, and become a serious source of danger.

Under the head of "Commutator or Collector," the author shows that the brushes which carry current may be touched by accident, "and prove a source of electrical danger." He therefore recommends that they should be boxed in, thus "making it quite impossible for the attendant to touch the metal *by accident* (italics in the original). He then states that "mica or glass fronts are used, &c." As glass, or mica either, for that matter, may be broken, we do not think that such a precaution renders a shock "quite impossible," although it minimises the risk. The author's opinion that a switchboard should have no back, *i.e.*, it should not be possible to get behind the board, but that all connections should be made in front, is open to question, and opinions are divided upon the point. There should, however, be no objection to the back of the board being accessible, provided only skilled attendants are permitted there, that plenty of room is allowed, and that it is placed under lock and key, which latter should be in the charge of a responsible man.

The article contains much that is interesting and instructive, but, unfortunately, it is quite obvious that throughout the author has in view solely the apparatus in use at Deptford, and therefore, many of the points do not apply to any other station in this country. As an illustration, he says: "As far as possible, also, no switch or regulating device carrying high pressure current should be touched, except the handle used is connected to earth." Seeing that switch handles in ordinary high tension stations are almost invariably made of insulating material they do not require earthing.

The two photographs of the Deptford switch gear are interesting, the second reminding one strongly of a railway signal box with metal levers.

In the first picture the attendant, who is standing between two boards, appears uncomfortable as though expecting a shock. In dealing with "Apparatus at Distributing Stations," after referring to the frequency of accident in such places and the necessity for care in design, the author says, "Although he (the engineer) may know all the connections, &c., himself, it is quite possible in a year's time for him to send a workman in cases of emergency who will have to trace everything out for himself." This is the very thing which we have always condemned. No workman should be allowed to touch high tension apparatus at all except under proper supervision, and after the part to be touched has been made "dead" and earthed.

On the question of what pressure will kill a man, the author says, "Much depends on the state of a man's health and the nature of the contact he makes. Two hundred volts alternating current if applied to some persons through the palms of their hands would give a very unpleasant shock, and in some cases might prove fatal, whereas men have been known to have had 10,000 volts through them and have returned to work at the end of a few weeks none the worse. In fact, in the author's opinion there is a certain amount of *safety* to life in dealing with extra high pressure currents, since no actual contact with the conductors can be made owing to the current jumping across the air space between the metal and the body before the man actually touches the metal, throwing him from it before contact is made."

No doubt under certain conditions 200 volts would prove fatal; for example, in a case of a person suffering from heart disease, but it need not be 200 volts alternating, if good contact is made a continuous current of the same pressure would effectually stop the heart.

As regards *safety* to life in dealing with extra high pressure, we are afraid we must deliver the Scotch verdict of "not proven," for although we have heard the same statement before we should like more evidence.

The author makes a statement which will, we feel sure, be endorsed by all high tension engineers. In speaking of regulations for the prevention of accident he says: "Much depends upon the men themselves. Intemperance is fatal." It is a well-known fact that when every possible means is apparently taken to protect men they will still get into trouble either by omitting to use the safeguards provided or by deliberately breaking the regulations drawn up for their safety. The Electrical Review's suggestions for dealing with apparent death from electric shock are given in full. The article is interesting, and its general tone proves that the author not only realises the necessity of taking every precaution for the protection of the lives of those employed by companies and others supplying electrical energy on the high or extra high tension system, but that as far as Deptford is concerned, he has done much towards carrying such precautions into practice.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

7,466. "An improved electrical switch." T. D. Dundas. Dated April 10th.

7,471. "An electrical apparatus or machine for the display of cartoons, autographs, diagrams, numerical results, advertisements, &c." A. Jack. Dated April 10th.

7,479. "Improvements in secondary batteries." P. M. Justice. (The Press Electric Storage Syndicate, Limited, South Australia.) Dated April 10th. (*Complete.*)

7,494. "Improvements in or relating to electrically-controlled valve gear for gas and other motors." A. J. Boult. (D. W. Payne, United States.) Dated April 10th. (*Complete.*)

7,523. "An improved clip for shades for electric lamps, candles, or other illuminating devices." E. Dunand. Dated April 10th.

7,525. "Improvements in telegraphic transmitting, receiving, and translating arrangements." A. Muirhead. Dated April 10th.

7,527. "Improvements in thermo-electric batteries or piles." J. Matthias. Dated April 10th. (*Complete*)

7,577. "A new or improved method and apparatus for operating contacts for electric traction." A. Ballance and S. A. Jefferson. Dated April 10th.

7,579. "Switching apparatus for controlling the distribution of electricity." J. Liddle. (J. Cloos, United States.) Dated April 11th. (*Complete.*)

7,580. "Switching apparatus for controlling circuits." J. Liddle. (J. Cloos, United States.) Dated April 11th. (*Complete.*)

7,584. "Improvements in electric switches." Crompton & Co., Limited, and H. W. W. Dix. Dated April 11th.

7,589. "Improvements in the construction of electric arc lamps." J. A. Fleming. Dated April 11th.

7,618. "Electrical apparatus for diminishing the apparent self-induction of alternating current circuits, and capable of being used in lieu of condensers." G. D. Abel. (La Societe Anonyme pour la Transmission de la Force par l'Electricite, France.) Dated April 11th.

7,641. "Improvements in Hertzian wave telegraphy to enable signals to be transmitted to any distance by means of intermediate relay stations." P. H. Cole and B. Cohen. Dated April 11th.

7,650. "Improvements in or relating to sockets or connections for electric light fittings." H. A. Knight. Dated April 11th.

7,654. "A method of and apparatus for starting alternating current electro-motors or bringing them up to synchronism." W. Du Bois Duddell. Dated April 11th. (*Complete.*)

7,656. "Improvements in current collectors for electrically driven vehicles." R. E. Carroll. Dated April 11th. (*Complete.*)

7,680. "Improvements relating to galvanometers, voltmeters, and the like electrical instruments." C. H. Offord and A. C. Barfield. Dated April 12th.

7,713. "Improvements in or relating to wireless telegraphy." W. H. England. Dated April 12th.

7,756. "Improvements in magneto-electric generators or dynamos." Sir W. Arrol and T. B. Murray. Dated April 13th. (*Complete.*)

7,761. "Improvements in or relating to telegraphic transmitting instruments." J. Gardner. Dated April 13th.

7,776. "An improved method of adapting existing fittings for the electric light." B. M. Drake and J. M. Gorham. Dated April 13th.

7,785. "Automatic electric time switch." A. B. Webber. Dated April 13th.

7,800. "Improvements relating to fusible electric cut-outs." H. G. Calthrop. (C. E. Peebles, Orange Free State.) Dated April 13th.

7,814. "Quick action reciprocating motion chiefly for making and breaking electrical circuits." J. S. Richardson. Dated April 14th.

7,863. "Improvements in electrical incandescent lamps and in their manufacture." F. M. F. Cazin. Dated April 14th.

7,883. "Improvements in vehicles electrically propelled from a line-conductor." W. M. Wheatley. (D. G. Stoughton, United States.) Dated April 14th. (*Complete.*)

7,886. "Improvements in apparatus for producing electric sparks." H. H. Lake. (A. R. Shattuck, United States.) Dated April 14th. (*Complete.*)

7,887. "An improved electrical percussive apparatus." S. R. Skellorn. Dated April 14th.

7,892. "Improvements in electrical batteries." E. W. Jungner. Dated April 14th.

7,895. "Improvements in or relating to wireless telegraphic apparatus." W. H. England. Dated April 14th.

7,918. "Improvements in the manufacture or production of bands and strips of copper and other metals by electrolysis on rotary mandrels." W. E. Heys. (E. Dumoulin, France.) Dated April 14th. (*Complete.*)

7,924. "Improvements in continuous current electric dynamos and motors." J. Atkinson. Dated April 15th.

7,925. "Improvements in and connected with globes for electric arc lamps." H. Stenz and J. J. Weyer. Dated April 15th. (*Complete.*)

7,927. "Improvements in or relating to electric contact makers and breakers." E. Perks. Dated April 15th.

7,942. "Method or methods for finding the direction and position of a transmitter of Hertzian waves." C. J. Evans, E. Wilson and H. Godsal. Dated April 15th.

7,943. "Improvements in apparatus for use in wireless telegraphy." S. G. Brown. Dated April 15th.

7,953. "Improvements in and relating to mechanism for automatic or coin-freed machines for the sale of electricity, gases or liquids." A. G. Brookes. (L. Sell, Germany.) Dated April 15th. (*Complete.*)

7,978. "Improvements in and relating to electric motors or dynamo-electric machines." R. Lundell. Dated April 15th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, January 18th, 1899, being date of application in United States.) (*Complete.*)

7,979. "Improvements relating to methods of and means for regulating electric motors." R. Lundell. Dated April 15th. (Date applied for under Patents, &c., Acts, 1883, Sec. 103, March 3rd, 1899, being date of application in United States.) (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free, 2d. (in stamps).*

1897.

4,442. "Improvements in or connected with electric batteries." J. L. Dobell. Dated February 18th, 1897. Porous cells, or the like, especially cells for use in batteries having fused oxides or other substances as electrolytes, are made of calcined magnetite ground to a powder, moistened with boracic acid dissolved in water or spirit, or in both, and kneaded into the shape required, after which the articles are dried or baked. 1 claim.

4,712. "Microphone worked by granular coal." J. O. Zwarg. Dated February 22nd, 1897. Microphones in which granular carbon or coal is used are formed of a metal box having an opening in the back for filling with granular material. The face has a number of oblique perforations through which the granular carbon passes to the diaphragm. The diaphragm is held in position by a ring and insulated screws, a mouthpiece being screwed into the ring. 3 claims.

6,292. "Improvements in electric incandescent lamps." A. Stowell. Dated March 10th. *Relates to Incandescent Lamps.* In order to prevent vibration or sagging of a filament, it is passed through slots or holes cut in a piece of mica or other suitable material, which is fixed across the middle of the bulb by placing its ends in impressions in the glass or otherwise.

6,428. "Improvements in electrical switches and cut-outs." H. C. Gover, C. F. Procter, and A. H. Bate. Dated March 11th, 1897. Relates to electro-magnetic switches, which may act automatically or may be operated from a distance. The contact arm or fork is adapted when in the one position to complete the circuit between the contacts, and it is held in this position by the end of the weighted arm catching under a roller carried by the armature of the electro-magnet. This armature normally is away from the magnet. The magnet coils may be in series with the circuit through a link, or it may be energised from a distance. When the current through the magnet is sufficient, the armature is pulled into the position shown and lifts the roller, allowing the rod to fall. This pulls the arm out from the contacts, the movement being assisted by the end acting against the roller. The forked arms normally tend to spring together, but are forced apart to make good contact by a nut. 3 claims.

6,773. "Improvements in connections of telephonic and telegraphic instruments to conducting lines." L. Maiche. Dated March 15th, 1897. Telegraph and telephone lines are arranged so that any pair of lines bearing instruments may be used as a lead or return for another set of instruments without interference. Thus, as an example, four metallic circuits carry four separate sets of instruments individually, but may have circuits A and B, C and D, used as other metallic circuits, or A and B may form lead, and C and D a return for a seventh metallic circuit. The specification describes telephone instruments as used on the metallic circuits, and telegraph or telephone instruments inserted in the earth return circuits. In a form shown, a pair of lines forming a metallic circuit, and capable of use as the line with an earth return through lines connected to the loop at the centre of the secondary coil of the induction coil. The receiving instrument is shown in a bridge. The positions of the transmitting and receiving instruments may be reversed. Each side of a metal loop may also be used as the line with an earth return. 5 claims.

10,040. "An improved coupling for attaching electric wire conduits to junction boxes." G. C. Marks. (J. P. Coghlin, United States.) Dated April 22nd, 1897. Conduit tubes are attached to junction boxes by means of screw sockets passed through from the inside of the box and secured to the conduit tube by a sleeve. Gaskets are employed to make a tight joint. The insides of the socket and conduit tube are coated with insulating material. The socket may have an internal screw for the conduit tube and an external lock nut, or two lock nuts may be employed instead of one and a fixed nut end. 7 claims.

10,168. "A new or improved mode of long distance telephoning, and apparatus therefor." I. Giuliani. Dated April 23rd, 1897. In systems of long distance telephony, the transmitter is arranged as a shunt to the battery in the main line. A three-way calling switch is employed, by which, when the lever is on a single contact, a call can be sent or received, but the lever must be placed on the two contacts for battery and microphone for signalling. 2 claims.

18,871. "Improvements in electro-magnetic contact systems for electric railways." W. Graunow, jun., J. A. McElroy and J. H. McElroy. Dated August 14th, 1897. Relates to electric railways and tramways on a sectional conductor or road-contact system with electro-magnetic switches. The electro-magnets on the vehicle which throws the switches are excited by a shunt round the motors or from a battery which is automatically cut-out when the main circuit is completed. The collector consists of shoes carried by toggle-levers, and depressed by a spring surrounding a guide, but a long collector may be used. The switching appliance is enclosed in a water-tight square box with a screw cover and a tubular bottom portion. Inside is a loose plunger which is lifted by the magnets so as to cause the contacts to touch the underside of the lid of the box. The feeder is coiled round the upper parts of the plunger before being connected to it, so as to magnetise it, and to maintain it in the raised position while current is being taken from the surface of the box or from sectional rails electrically connected thereto. Flanges on this box permits its attachment to the insulated sectional rails and the stringers which support them. Structural modifications in these boxes are also described and illustrated. In another modification, the box is made continuous. 7 claims.

18,941. "Improvements in and relating to electric alarm and registering apparatus." C. Junge. (M. Vester, Germany.) Dated August 16th, 1897. An alarm or signal is given in any number of receiver stations, such as the bedrooms of an hotel, from a central station, such as the servants' room, the operations being at the same time duly recorded and indicated in the central station. When, as on the occasion of a fire, it is desired to operate simultaneously the bells in all the receiving stations, a sliding board which is automatically held down by catches is used to press on all the pushes. 3 claims.

18,989. "An improved method of, and apparatus for, the production of calcium carbide; applicable also to other purposes." H. Maxim and W. H. Graham. Dated August 17th, 1897. Several parallel horizontal electrodes on one side of a firebrick furnace are connected separately through switches and current meters with the conductors of a polyphase alternator or other current generator. Corresponding electrodes, or one common electrode, on the other side of the furnace are connected to a return conductor. For making calcium carbide, the furnace is preferably used by placing small carbon rods between opposite electrodes, and covering them with powdered lime 100 parts, and coke 65 parts; a mass of carbide is formed between opposite electrodes and is removed with tongs after the current through it has been stopped. This operation is repeated on each pair of electrodes successively, so that the total power taken by the furnace remains approximately constant. The furnace may be used for the reduction of metals. The outer ends of the electrodes are supported by screw-threaded rods, and are pressed towards the furnace by springs; they are movable outwards by nuts with handles to permit insertion of fresh connecting carbons. The furnace may be divided into separate compartments for the pairs of electrodes. 8 claims.

19,229. "Improvements in electric railway on the sectional conductor system." L. E. Walkins and F. W. Dickinson. Dated August 19th, 1897. Relates to electric railways in a sectional conductor system with switches thrown mechanically and released electrically by the passing vehicle. The conductor (in insulated sections of, say, 1,000 feet) is connected to the main conductor by the switch which is operated by a pinion and rack worked by a treadle adjacent to one of the rails. The treadle is returned by a spring, but the rack is held by a rachet and pawl until released by an electro-magnet. These magnets are excited by separate circuits completed in the next box by a switch operated at the same time as another switch. In a modification, the two switches are operated by a rock-shaft and treadle lying in the insulating part between the sectional conductors. 6 claims.

1898.

19,951. "Improvements in electrical gas lighters." E. Seiler. Dated September 20th, 1898. Relates to an arrangement for lighting gas burners by means of an electric spark with the help of a periodical auxiliary flame which is lighted automatically when opening the gas cock, and is extinguished after it has lighted the principal. Consists of an electro-magnet arranged under the burner gallery, whose armature causes a current break forming sparks laterally to the chief burner before the mouth of an auxiliary burner, the gas conduct to this auxiliary burner being open during a certain period of the part revolution of the cock during which period also an electric contact attached to the gas cock is closed. 1 claim.

20,894. "Improvements in trolley ears for electric railways." The British Thomson-Houston Company, Limited. Dated October 4th, 1898. Relates to trolley ears for electric railways. Consists of a plate having a substantially straight under side, holes formed in the plate near the lower edge, holes formed near the upper edge of the plate, and a holder or support filling the holes in the upper edge of the plate. The ear is fixed to the trolley wire by compressing the metal forming the wire around the ear. 6 claims.

20,895. "Improvements in electric surface contact railway systems." The British Thomson-Houston Co., Ltd. Dated October 4th, 1898. Relates to surface contact railway systems. The invention has for its object to provide a safety device which will indicate definitely whether or not a contact over which the car has just passed has been left "alive" in the street. For that purpose the vehicle is provided with an automatic circuit-breaker, having its actuating magnet connected between the ground and a supplemental or testing shoe, which will make contact with the the sectional conductor after the shoe furnishing motor current has left it. With the circuit-breaker may be combined a visual signal. Also combined with it is a registering device showing whether it has been opened. 2 claims.

20,991. "Improvements in or relating to phonographs." J. Cohn and J. S. August. Dated October 5th, 1898. Relates to improvements in phonographs. Consist in the attachment of the recording cylinder upon a metal cylinder in such a manner that in this latter cylinder a number of tongues are cut and these are bent so as to form springs which press tightly against the inner wall of the recording cylinder and prevent any axial rotation of the same upon the metal cylinder. The flanged front end of the cylinder acts as a bearing and is provided with openings to facilitate the removal of a too tightly fitting cylinder by means of the fingers. A roller of either conical, concave, or convex form, runs upon an axis parallel to the guiding spindle upon which the carriage travels, and so relieves the nut of the carriage. Consequently the driving mechanism is of much less power. 3 claims.